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ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Improved "Prentice" Lathe.

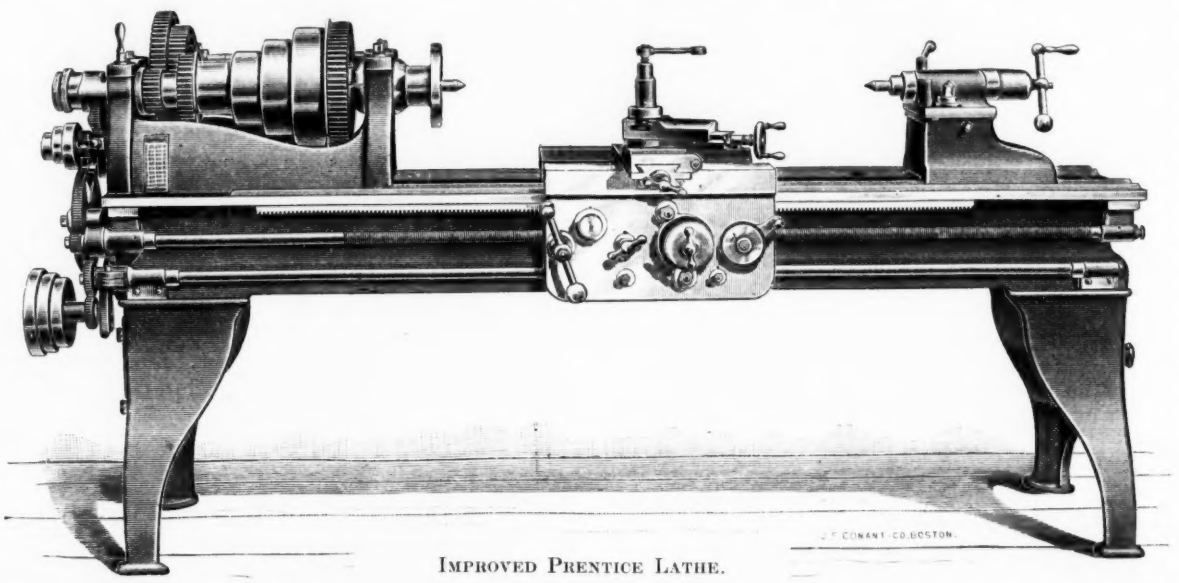
With this we give an illustration of a lathe which has recently been brought out by Prentice Brothers, of Worcester, Mass.

The chief departure from the usual practice in lathes of this class is in the use of double back gears by the employment of which the lathe is given not only a wider range of speeds than is usual, but there is less variation between successive steps of the cone pulley, so that a speed more nearly approaching the exact correct one for any given job can be secured.

The spindle is of steel, running in hard bronze boxes, and the end thrust is taken by a device which is attached directly to the head and not to the rear spindle box. The lower feed cone runs on a stud which is placed in a swinging arm held by a clamp bolt to the feed-rod box, while gears, which can be changed, give any desired rate of feed. This also serves to keep the feed belt at the proper tension, without the necessity for re-lacing it.

The apron contains an open and shut nut, used in screw cutting; friction connections for lateral and cross-feed; and a sliding pinion for the lateral feed. The sliding pinion is to throw the feed connections out of gear, when cutting screws, and there is no annoyance from revolving handles. A receptacle is provided in each leg, where change gears, tools and wrenches can be kept, free from dirt and oil. Countershaft has improved hub friction pulleys and noiseless clutch.

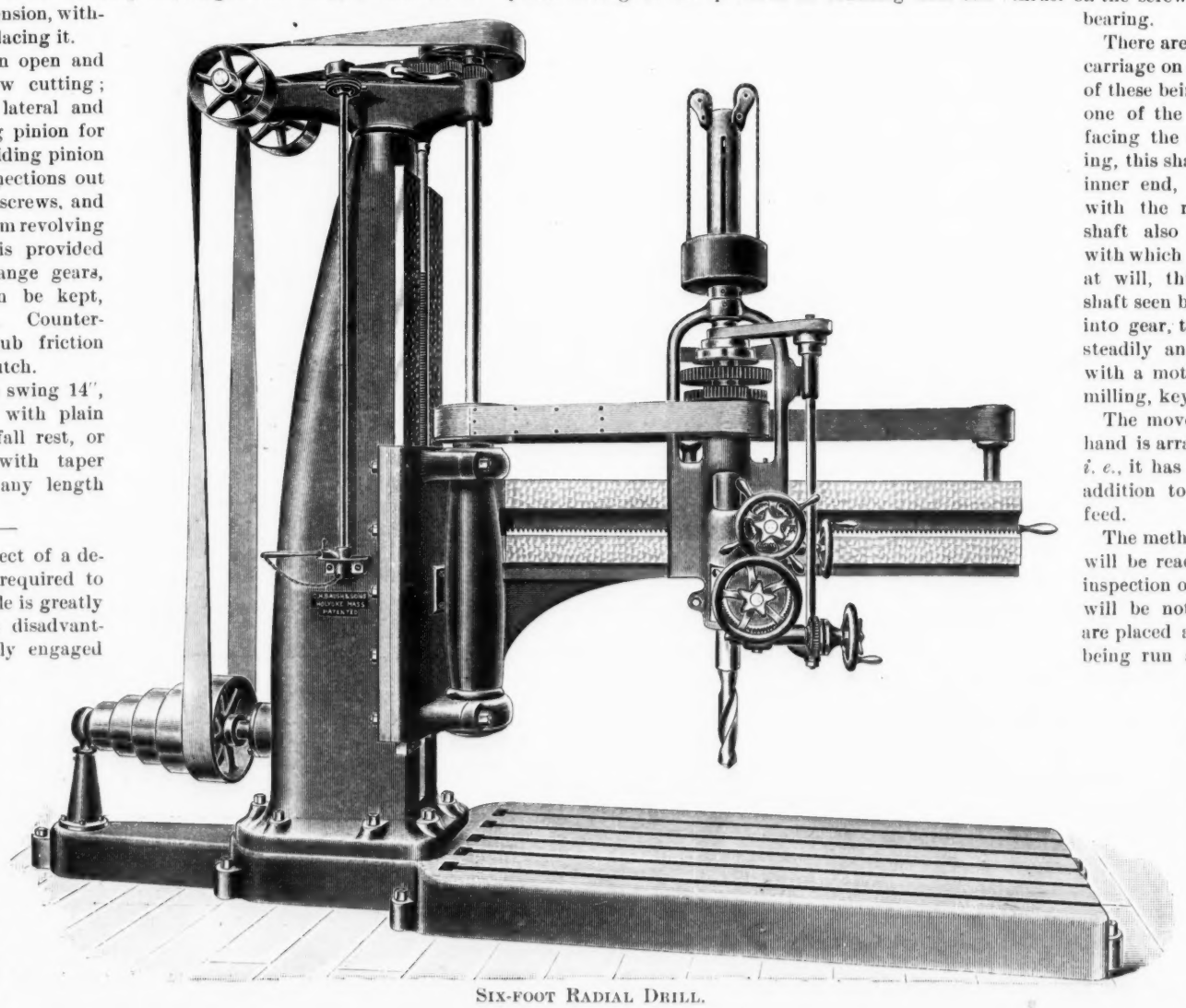
The lathes are built to swing 14″, 16″ 18", 21″ and 24″, with plain gibbed rest, raise and fall rest, or compound rest, also with taper attachment, and with any length of bed.



IMPROVED PRENTICE LATHE.

Generally the first effect of a device whereby the labor required to produce any given article is greatly reduced operates to the disadvantage of the men directly engaged in the production of the article. Changes are made that throw men out of work, forcing them, temporarily, at least, into other channels. But these things right themselves very quickly, and, in the end, the workingman is invariably benefited. More and more every year the machine is made to do the work while the man controls its operations, and the increased output puts the product within the reach of all. Cheapening a product means increased consumption, and not infrequently this means more men employed in a given industry. Really the only unfavorable thing connected with the introduction of labor-saving machinery is the temporary embarrassment of workmen.

There is, all over the world, where steam engines are used, a difference of opinion as to the efficiency of the steam jacket. The fact that this cannot be more easily settled is an evidence of the lack of positive knowledge in the science of steam engineering. There ought to be some concerted effort to determine what influence the varying conditions under which steam engines are operated have upon steam jackets. Such an effort would clear up a good deal of what is now a mystery, and enable steam engine builders to work with a better understanding of the problem of reducing coal consumption. Concerted action ought to bring this about, for the good of every one, and such action hardly seems too much to be hoped for.



SIX-FOOT RADIAL DRILL.

Six-foot Radial Drill.

The accompanying illustration is of a new radial drill which has recently been made by C. H. Baush & Sons, of Holyoke, Mass.

It will be noticed that the bed of the machine is relatively large and heavy, and that it extends far enough at the rear to support an outer bearing for the cone pulley shaft. The column is of a form well adapted to withstand the stresses to which it is subjected, and has fitted to it a long and broad saddle to which the arm is pivoted, the weight of the arm being supported upon a ball bearing so that it is very easily turned to any desired position.

The screw for moving the saddle and arm vertically is let into the face of the column, so that it is not liable to injury, which liability is still further decreased by the fact that the screw does not come down to where most of the work is placed. The end thrust on the screw is also taken by a ball bearing.

There are two movements of the carriage on the arm, the more rapid of these being effected by the upper one of the two hand-wheels seen facing the observer in the engraving, this shaft having a pinion at its inner end, which engages directly with the rack in the arm. This shaft also carries a worm-wheel with which a worm can be engaged at will, this worm being on the shaft seen below. With this thrown into gear, the carriage can be very steadily and powerfully fed along with a motion suitable for vertical milling, keyseating, etc.

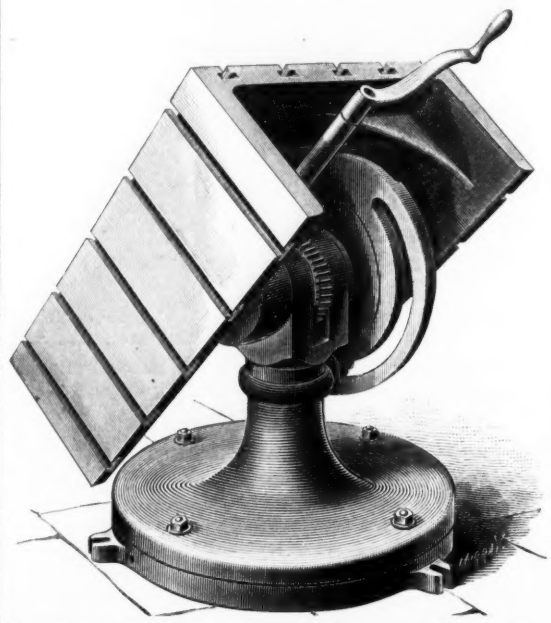
The movement of the spindle by hand is arranged in the same way, *i. e.*, it has two motions by hand in addition to the regular automatic feed.

The method of driving the spindle will be readily understood from an inspection of the engraving, and it will be noticed that the back gears are placed at the spindle, the belts being run at high speed, and the transmitting shafts subjected to a comparatively small torsional stress.

The spindle is balanced by means of the collar seen above the carriage.

We illustrate separately, on page 2, a universal table which may or may not accompany the drill, as desired. As will be perceived, the base is double, so that the table swivels in a horizontal plane to any desired position, in addition to which the table can be moved in a vertical plane by means of the worm and worm-wheel

seen to any desired angle, and can then be firmly clamped, graduations indicating its position in degrees. The machine weighs about 17,000 pounds, exclusive of the table above described.



UNIVERSAL TABLE FOR RADIAL DRILLING MACHINES. SEE PAGE 1.

Practical Brass Founding.

BY ALEX. CAIRNS.

THIRD PAPER.

SQUARE FURNACES.

Fig. 6 is one of the latest types of the square furnaces. Like the round furnace, it is built for a No. 50 crucible; it is 34″ square outside, and 40¾″ high.

The plates *B B* are 33″x40″x½″ thick, and have lugs cast on them to correspond with the lugs *E E E* on the plates *A A*. The latter plates are 34″ wide, and 40″ long, and ½″ thick. At the bottom an entrance 21″x6″ is cast for draught and to facilitate cleaning out the ashes.

The grate bar bearing shown between *c* and *d* on the left is 1¾″x24″ long, leaving room for 8 grates 1½″ square, and spaces between to correspond.

At *o* is shown the flue for which a square hole 5″x5″ should be cast in the back plate *A* to allow the building of the flue onto the stack.

Through the lugs *E E E*, cast on the side and end plates, ½″ rods 35″ long are passed, which bolt the furnace together. The holes in lugs should be ⅛″ larger than the rods, or ⅝″ in diameter. The top *C* is 34½″ wide, 44″ long and ½″ thick, the flange or lip is 1½″ deep and ½″ thick tapering down to ¼″. At *i i i* are cast tits or equivalents, to facilitate getting the cover *D* in its proper place.

Holes *J J J*, ⅝″ diameter, are cast or drilled in the top, through which the ½″ bolts *K* are passed, the hooked ends of which come out of the plates *B* at *L*.

The slots *m m* take up the expansion due to heat at the inside of furnace top; they should be 3/16″ wide, and 2½″ long.

The diameter of the furnace mouth *V* is 15″. Here it may be remarked that square furnaces usually have square mouths, but the special benefit derived from square furnace mouths is not plain. As we have started with the intention of confining all the heat possible in the furnace, it is reasonable to suppose that more heat will escape from a square mouth than a round one, and as there is ample room in the round mouth to lift out the crucible and tongs, we do not see what benefit is derived from a square mouth.

At *o* is shown the flue, which can be built to the stack as shown. The best modern practice is to make the flues 4″x4″; whether this is correct, a review of thermodynamics alone can determine, which, however, will be discussed briefly further on.

At *p p p* are shown the grate bars 1½″ square; they are that much longer than the dimensions of the outside of furnace as will admit of grasping and shaking them.

The lining support *q* is ½″x2½″ wide. Two or three expansion slots should be cast in each, because the support, from successive expansions on the inside, will eventually bow the plates *A A* and *B B*.

The method of interlocking the brick in the corners is shown at *r r r*.

The lower two rows of brick will wear out first. To avoid taking out the whole lining in order to replace the lower bricks, a support at *x* is cast on the plates to support the lining above; for taking out two rows it should be 4″ from the lining support, and for three rows, 6″; ¼″ thick and 2″ wide will be strong enough, and the intervening space caused by it, between the brick, can be stopped up with mud. In lining up the furnace the intervening spaces should be filled in with fire-clay previously mixed to the consistency of clay-wash.

The plan of laying the last row of brick is shown at *S*, and that of the second last row at *F*. The idea is to confine the heat as much as possible, and also to protect the top. A sectional view of the top rows in the corners is shown at *T*.

It will now be seen that the furnace inside is 25″ square, being equal to the outside dimensions, less 1″, the thickness of the plates, less 8″, the width of two layers of brick, laid edgeways to the fire. The depth of the furnace proper is 28″. At *D* and *E* are shown two styles of furnace covers, either of which will produce like results. Both of them are intended to be lined, and, if made in halves, nails should be cast in as shown, to secure the lining at the joints. They should have a lap of ¼″ of lining all around the furnace mouth, so as to guard against any exposure of the corner shown at *a* on *D*, and *a* at *E* cover to the heat of the furnace, which as a visit to any of the large brass furnaces will show; such furnaces are not encased in a cast or boiler-iron shell.

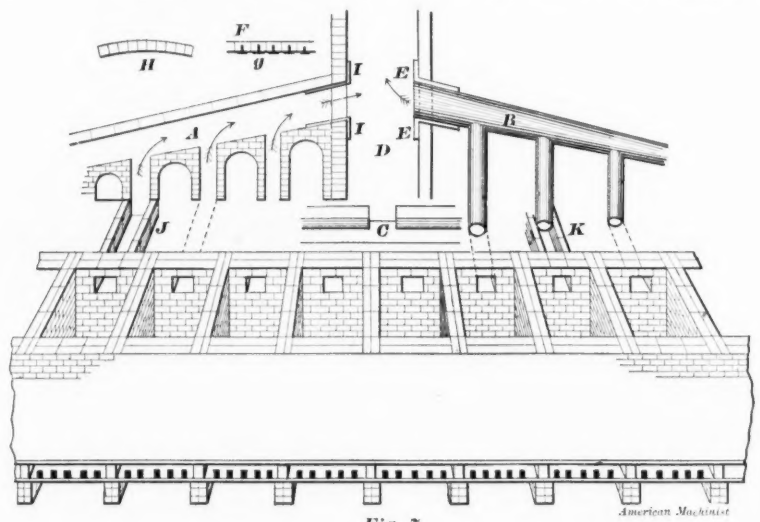


Fig. 7.

Fig. 7 shows the general arrangement of furnaces built in batteries. Crucibles from No. 50 up are generally used in them, with 6″ to 12″ of coke around the crucibles, hence the furnaces must be built to take this amount of coke, plus the bilge diameter of the crucibles, and from twice the depth of the crucible for a No. 50 pot to three times the depth of the crucible for a No. 300 pot.

At *A*, *B* and *C* are shown three flue arrangements, of which there is practically no preference as far as draught is concerned, but as regards cost, *B* and *C* have the preference.

The flue *A* is built of brick as shown; it is very substantial, and enters the stack by means of the cast-iron frame shown at *I I*.

The roof can be arched, as shown at *H*, or built straight, as shown at *F*, the brick being supported by cast-iron T irons shown at *g*. The arched top is, however, preferable as the cast T irons will work the brick loose from its expansion due to heat.

The pipe *B* can be made of tin or sheet-iron, with a cast-iron entrance to the stack as shown at *E E*. It does not necessarily have to be tapered as shown; the size will, of course, depend on the number of flues entering it. If we use a 12″ main pipe, and say four 6″ pipes, the volume of air or smoke passing from the four 6″ pipes into the 12″ pipe, will not fill the latter, for the reason that the practical diameter of the 6″ pipes is lessened by friction; and while the combined areas of four 6″ pipes are equal to the 12″ pipe, we may take five 6″ pipes, and 7/16 of another 6″ pipe to fill the 12″ pipe properly; hence, five 6″ pipes can be used in connection with a 12″ pipe, without danger of choking the draught.

At *J* and *K* is shown the brick-work connecting the horizontal flues with the perpendicular ones.

At *C* is shown a style of horizontal flue much used on account of its cheapness. It is a square box or trough built in proportion to the number of flues entering it, and covered, as shown at *H* or *F*.

Fig. 8 shows the plan of furnace pits. *A* and *B* are two lintels on which the flues can be built. *G* shows the rib of the lintels, which is placed downward. *C* is the smoke-stack, and *E* a brick support for the lintels, at *D* are two short columns, obviously to support the lintels. At *F F F* are shown the furnace supports, which can be made any height to suit, and be set on cast-iron plates for a foundation.

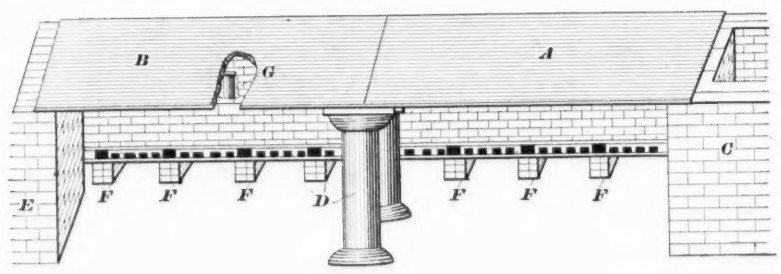


Fig. 8.

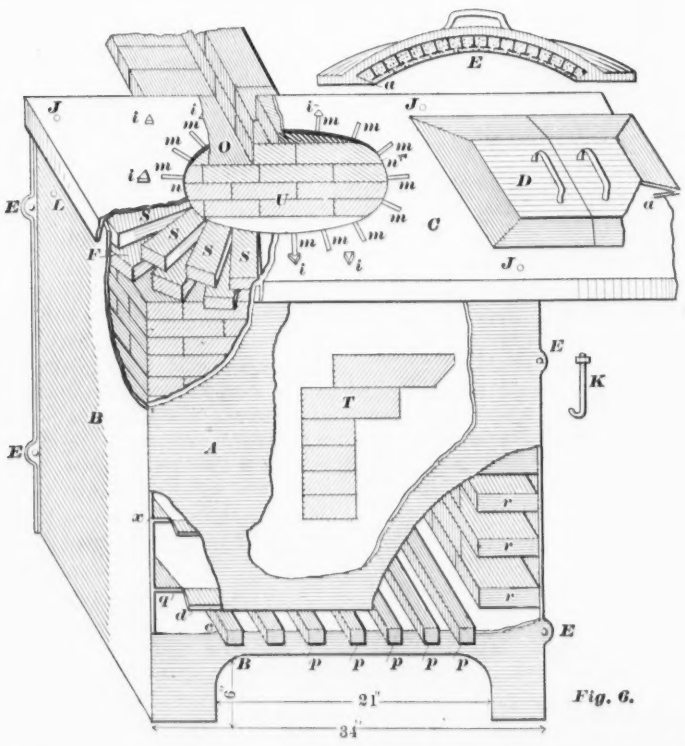


Fig. 6.

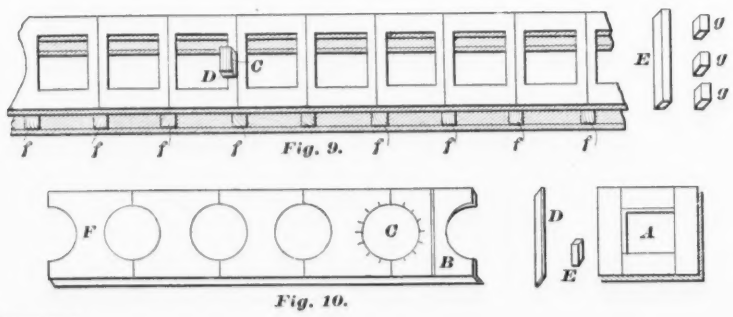


Fig. 9.

Fig. 10.

In Fig. 9 is shown the lining and grate bar support. The plates *B* are set on the furnace supports shown at *F F*, Fig. 8, and leveled up. Bars *E* are set on the small

blocks *g g*, so as to raise the plates *A* high enough to allow for play of the grate bars. As 1½″ square iron will do for the grates, the *E E E* and *g g g* bars will need to be slightly larger, say 1¾″ or 2″ square; they should be set as shown at *f f f* between the joints of the plates.

At *C* is shown a brick set in its proper place, and *D* shows the extension of it over the support.

Fig. 10 shows the plan of the tops. A pattern, as shown at *F*, should be made, and as many castings made from it as are necessary to cover the furnaces. In making the ends, instead of stopping one-half of the mold off with sand, as is usually done, a strip of wrought iron *D*, ⅛″ thick, and the width equal to the thickness of the casting, should be oiled, a little plumbago shaken on the oil, and the strip set in the middle of the mold as shown at *B;* a small piece *E* can also be set in the flanges of top, thus making the two end pieces in the one mold.

Expansion slots, as shown at *C*, should be cast in the tops to prevent them from cracking.

At *A*, Fig. 10, is a form of top that seems to have found favor with some, but where its commendable points are I am at a loss to know; it consists of plates the width of the furnace, and two short plates placed between them, which are continually working loose.

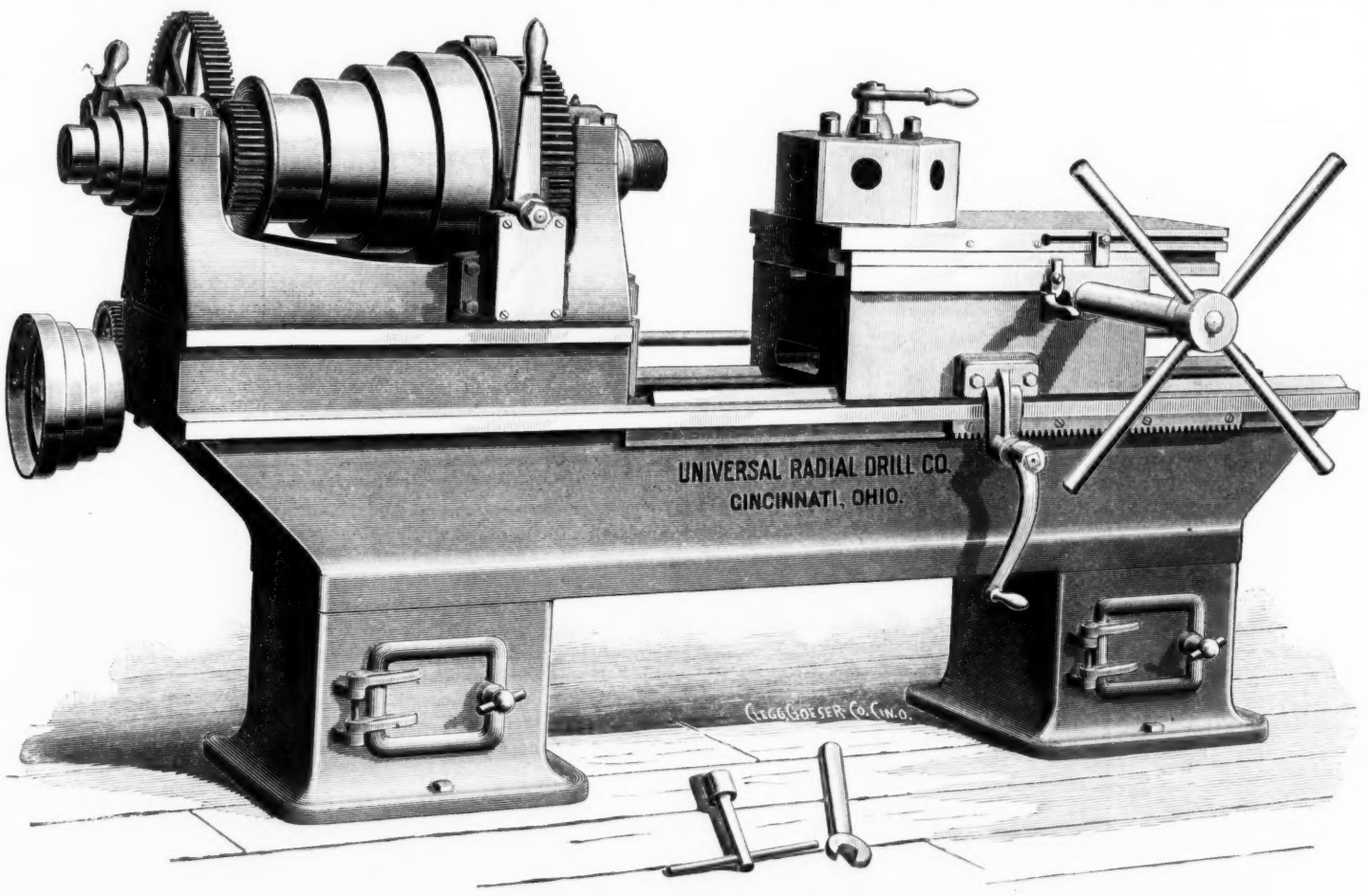
The furnaces shown in Fig. 7 are as they are being built at the present time; but I would recommend building the last two rows of brick, as shown in Fig. 6, if for no other reason than to keep the tops from cracking and warping.

It sometimes happens that the pits cannot be arranged on the outside, as shown at Fig. 8; in this case they should be built in front, as is usual, and a tunnel or connection with the outside made, so that the furnaces can get cold air for draught, and to allow the ashes to be taken from the pits without interfering with work in the shop.

Thirty-inch Turret Chucking Lathe.

We present herewith an illustration of a thirty-inch turret chucking lathe, having a length of bed of 7′ 4″, and designed for the heaviest work within its capacity. The head is provided with a friction device for changing from back gear to cone pulley speeds without stopping; has a hollow spindle—$2\frac{1}{16}$″ hole.

The turret has an automatic feed which can be released automatically at any point; turret revolves automatically, and is free at one point, so that it can be turned by hand in either direction; has six 2″ holes, and flat faces to which tools can be secured if desired. The turret block is moved along the bed by means of the rack and pinion movement seen in front. The extreme swing over the bed is 31″, and the machine weighs about 3,200 pounds. The builders are the Universal Radial Drill Co., Cincinnati, O.



THIRTY-INCH TURRET CHUCKING LATHE.

It is now thought that a plan, comprehensive in detail, will be brought before the next Congress to control immigration. It is coming to be understood that European countries are, notwithstanding such laws as are in force, sending their undesirable population to this country, and this is entirely undesirable so far as this country is concerned.

On the Cultivation of Inventive Capacity by the Solution of Constructive Problems.

BY LEICESTER ALLEN.

I am sorry that the following criticisms compel me to introduce more of my own comments in the discussion of the problem published in the issue of the AMERICAN MACHINIST for October 8th than I would otherwise feel warranted in doing.

Mr. Francis W. Clough, of Springfield, Mass., states that "the second solution, Fig. 4, forwarded by Mr. Powers, of Beloit, Wis., and what he (Mr. Allen) calls the best, is a clear case of violation of his own restrictions. His first restriction is to employ *no crank or pitman*. Now, in Fig. 4, the plate is moved by a *crank-pin* coming in contact with lugs *d d* alternately. Again, one of the requirements of the problem, . . . was that the movement of the plate should be uniform, . . . having a period of rest between each alternate movement. Now, Mr. Allen undoubtedly knows that the movement of a slide by means of a crank-pin, whether by means of a connecting rod or a crank-pin coming in contact with a straight-sided lug, as illustrated in Fig. 4, is in no part a uniform motion, though I am frank to admit that with the shortness of the lugs the increase and decrease is far less than if the lugs were much longer.

"If the lugs in Fig. 4 had been made or shown to have other form for compensation, then the case might have been claimed for uniformity, but it is *a crank* which he did not want used. Am I not right?

"And when he says further that the motion of *a*, Fig. 4, may be indefinitely extended by the use of two pulleys instead of one, it would then be entirely a different arrangement than Fig. 4; but that is his suggestion, and not Mr. Powers', of Beloit, Wis., and if it is the best, it is a violation of his restrictions. He can patch up Mr. Powers' violation if he is disposed, but he must not complain if we kindly criticise him."

I do not complain of any kindly criticism, but welcome it. I do not claim exemption from liability to error. As a similar criticism has been made by Prof. De Volson Wood, I will first notice that before replying further to Mr. Clough's communication, as the two criticisms have points in common which may be treated together. Prof. Wood writes as follows:

"I put Mr. Powers' solution, Fig. 4, page 11, of AMERICAN MACHINIST for November 5th, before my class, and they criticised it as follows:

"The wheel and pin is equivalent to *a crank*, which was an excluded device.

"The motion of the slide would not be uniform.

"If motion is rapid, the slide might pass forward so far that the pin would not engage on the opposite side.

"The times of motion and rest might be such as could not be secured by the device (when he adds a belt or chain it will be the same in principle as mine), but with his arrangement the motion would be through a longer time than the period of rest; whereas, with mine, rest and motion can be made anything desirable."

Mr. Clough and Prof. Wood will both agree with me that problems, whether mathematical or mechanical, should be accurate in their statement, and that they should be read accurately if the conditions therein stated are to be satisfied in their solution.

From the Century Dictionary, now considered as authoritative in its technical definitions, I extract the definition of crank, presumably contributed to that excellent work by Prof. R. H. Thurston, of Sibley College, Cornell University.

"(2.) CRANK, a bend; a turn; a twist; a winding; an involution."

"(4.) A *bent or vertical arm* attached to or projecting from an axis at one end, and *with provision for the application of power at the other*, used for communicating circular motion, as in a grindstone, or for changing circular into reciprocating motion, as in a saw-mill, or reciprocating into circular motion, as in a steam engine."

The italics are mine, and I would make the criticism on this definition that the word "vertical" is superfluous, but the definition is in the main correct.

Now, it could not have been possible that I intended to exclude "a bend; a turn; a twist; a winding; or an involution," and if the first restriction, the one upon which the criticisms are based, be carefully read, it will be seen that it does not exclude *a crank*. What I did exclude was a *crank and pitman* or "any analogue of this mechanical movement, as the *crank and slotted crosshead*." The punctuation of the language, as well as the construction of the sentence, shows plainly that the writer considered the crank *and* pitman as one mechanical movement, and the crank *and* slotted crosshead as an analogue of such movement. The crank, therefore, was not excluded, but the *crank in connection with a pitman* or *a slotted crosshead*, or an analogue *of these combinations*. Now, I submit that the solution given by Mr. Powers is not an analogue of this movement, and that it is a correct solution. Neither is the criticism, that the slide is not moved uniformly by this movement, valid, because nowhere in the restrictions was it required that the slide itself should move uniformly. The sixth restriction includes what was said on this point, and it states that *the part or parts which directly move the slide a* must have a uniform motion. This cannot properly be understood as meaning that the *slide* must move uniformly. I do not wish to split hairs, but I thought that, in the restrictions, I used plain and unmistakable language.

I now proceed to extend the problem to its application to the movement of a shuttle carriage on the lay beam of a loom. At first I thought it would be necessary to make a diagram of a modification of Prof. Wood's solution, to illustrate this additional problem, but I think it can be made clear without occupying the space necessary for a drawing, and I now think the diagram would be too suggestive. Probably no one of your readers, likely to attempt a solution, is ignorant of the construction of the lay beam used in weaving on power looms, at least, so far as its general construction and operation is concerned.

Prof. Wood has indicated in his solution a way of making the period of rest between alternate motions of the slide as long as may be desirable, and hence by the use of his arrangement, or one analogous to it, the period of rest may be long enough at each throw of the shuttle to permit the stroke of the lay beam in beating the weft thread. It is now required to devise means whereby the movement may be applied to the oscillating lay in such manner as to move the shuttle carriage back and forth, and to give time at each end for the beats of the lay. In doing this, any kind of guideway may be used on the lay beam which carries the reed. The driving motion which operates the rag wheels must be a uniform rotary motion. With this exception, any slight variation in uniformity which may enter into the movement, through oscillation of the lay on its beam supports, is admissible. In other words, if the movement which drives the lay beam be disconnected so that the lay beam be stationary, the driving motion must be uniform, as stated.

Some communications on this subject having been addressed to me personally, I take

this opportunity to state that their proper address is to the editor of the AMERICAN MACHINIST.

Topical Questions at the New York Meeting of the Mechanical Engineers.

Last week we gave a running account of the events connected with the recent meeting of the mechanical engineers in this city, with a summary of President Hunt's address. As stated at the time, many of the topical questions were not presented at the meeting, but on some of those that were presented the discussion was interesting and instructive. We give below an abstract of it.

The first question presented was number 89:

"HAS ANY ONE EVER TRIED TO STANDARDIZE KEYS: IF SO, WHAT ARE HIS SIZES?"

The secretary read a communication from Mr. E. G. Parkhurst, superintendent of the gun department at Pratt & Whitney's, stating that in 1858 he adopted a standard for the size of keys as follows: One-quarter the diameter of the shaft for the width of the key, $\frac{1}{6}$ the diameter for the depth of the key, and the shape and taper of the key one inch to the foot; that he was led to adopt this for mining and quarrying purposes; that several years ago his formula was published, giving his name as the author, and shortly afterwards he was given quite a raking on the key question; that a few months later Mr. Thomas Shanks visited their works, and they exchanged shop formulas, and he found Mr. Shanks' formula was the same as that adopted by him a few years ago. He desired an exchange of opinion on the subject. He stated that he had reached a point where the key would hold enough to twist off the shaft.

Another member said: In mill work in Michigan practically that same standard is used almost entirely, except that there are no keys made except on $\frac{1}{16}''$ Of course, if you take a $\frac{16}{16}''$-shaft you put a $\frac{1}{4}$-inch key in, the taper being somewhat less—I think it was $\frac{1}{16}$ of an inch; but that is something that has not been standardized, and every shaft maker does about as he chooses, but with this understanding, that if a man sends in for a line of shafting the keys are to be $\frac{1}{4}$ the diameter of the shaft. All pulleys are keyed to the shaft. I do not think in any Michigan saw-mills I ever saw a pulley that was held to the shaft by set screws.

Another member: It is pretty well known to engineers who use keys to a great extent, that the keys hold better through top and bottom fits; that a narrow key has a tendency to roll, and that a flat key, *i. e.*, a key flatted on the shaft, without being laid into the shaft at all, will hold better, and do more severe work than a key that is let in $\frac{1}{4}$ the depth of the shaft. I would think myself, in all ordinary cases where the work was severe, particularly, I would have the key less than $\frac{1}{8}$ the diameter of the hole for the width.

Mr. Bond: I may say that with the system of keys adopted in our works the difficulty with the depth is overcome by dropping a circular milling cut into the stem or shaft, and a half circular key (of circular section) is fitted in very tightly, and in that way the side strain is taken up by the depth of hold, and a considerably narrower width of key is used; and by giving these keys a slight inclination, to give them the taper necessary to fit the top of the keyway in the pulley or gear, they adjust themselves to any position required. It is known as the Woodruff system. I have not the formula, but they obtained the data by testing to that point in which the key would stand the torsional strength of the shaft without shearing the key; and it is curious to know the keys are much thinner and narrower than any of the old formulæ would seem to recommend.

Mr. Rogers: I like that standard, for this reason: I have been asked four times within the last month by men working in the shops what my standard was for keys, and I did not have any; and I made one effort to find out if there was any standard, and what the standard was, but I did not find out; and I have taken the memorandum here with the intention of writing to two or three of those boys in the shop in regard to what their standard would be. There is one thing I do not like about it, and that is one-ninth of the diameter of the shaft. If you take a 2 and $\frac{7}{16}$ shaft, and a fellow in the shop has got a rule graduated in 16ths, in working that into ninths he gets demoralized, and I think he will try to forget that standard.

Another member: According to a list which I tried one time to get up for standardizing keys I followed very closely to the formulæ given to-night, but I arranged my keys into sixteenths, so that avoided the difficulty that the member just mentioned.

The secretary exhibited a blue print which he stated he had received from William O. Weber, which stated that the width of the key is a quarter of an inch for every inch of diameter of the shaft.

Mr. Ball drew a sketch (Fig. 1) on the blackboard, and asked the members if any of them had tried using keys of that form, putting them in in that way. "I have tried it with very good success. It seems to me now that the force acts in a direction tangent to the shaft at the edges of the key;

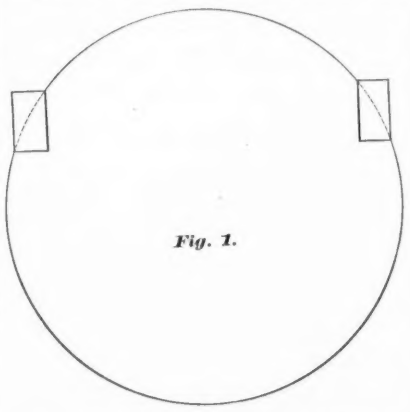


Fig. 1.

and the wider the key the more direct that force comes on the top of the key, instead of being a sliding force; and for that reason it seems to me that in this form of key the force comes very direct on the top of the key and on the bottom; and I have used these keys in some cases where I could not hold with ordinary keys, with very good success."

Another member stated that he had used such keys on heavy marine work with very good success.

The next question considered was number 90:

"HAVE YOU HAD ANY EXPERIENCE IN OUTDOOR NIGHT WORK IN WIND AND STORM WITH ANY APPARATUS OTHER THAN ELECTRIC?"

Mr. Kent referred to the Wells and Lucigen lights, and said he believed they were largely used in England. The air seems to be charged with the vapors of petroleum or a petroleum compound. It comes out with great force and gives a great light.

Mr. Rogers: I have seen that same light Mr. Kent speaks of, and I was under the impression that it was naphtha used under pressure. I have seen it used in clearing up wrecks on railroads, and I do not know of anything more adapted to that work. That is work that requires a good deal of light; and I have seen torches used, and flambeaus something similar to the Mississippi plan, but I think the best I have seen is the Wells light for that purpose.

The President: Of course in fixed plants the electric lights have become so common now that nothing else will satisfy us; but there are so many places where a temporary light is to be used that a good one is of great importance.

Mr. Cartwright: I have had a little experience in lighting at night. Of course the Wells light and the Lucigen light are good things. I have used for a year and a half, working night and day, the electric light, and what we call the Dago light; that is the light you see the peanut venders have on the corner of the street. It burns the plain kerosene. With the electric light and arc light the mosquitoes and Canada soldiers put the light out, and we used the Dago light and that burned them up.

The President: What is the Canada soldier?

Mr. Cartwright: It is the gad fly. On the lakes it is called the Canada soldier; they come in such quantities that they will fill the globe of an arc light within two or three hours. In Buffalo it is a question whether or not they won't carry the lamp-posts off.

Number 91 was next presented:

"WHAT IS THE BEST DESIGN FOR A LINE SHAFTING TRANSMITTING ONLY 50 HORSE-POWER, PERMITTING THEM TO BE STARTED AND STOPPED ON ANY FLOOR WITHOUT INTERFERING WITH THE MOTOR OR OTHER SHAFTING?"

Mr. Bond: In an addition to our shop for a small tool department, we have about 30 horse-power transmitted through a pulley to the upper floor, and that is arranged to disengage by the simple operation of a lever which can be detached and set up in the corner and be out of the way. Whenever the power is to be disconnected the friction is thrown out, and there is no disturbance of anything on that line.

Mr. McBride: I would state that I have a number of large machines of 50 horse power and upwards which I drive by belt. I use tightening pulleys for starting and stopping. I think a great abomination is a loose pulley. I have used those tightening pulleys on large belts, and have no trouble with them whatever. The distance between the centers of the shafts is about 18 feet, or something like that. They stop and start very heavy machines very readily without any trouble whatever.

Another member: One trouble with friction clutches in connection with such matters oftentimes is the difficulty in getting the lubricant where it wants to be; if the clutch is stopped much of the time the portion of the pulley which revolves on the shaft is apt not to be lubricated. I find that is very satisfactorily overcome in many cases by, instead of using a brass bushing, to use a graphite-filled bushing. By that means it will work for a year or more practically without any hurt; whereas, otherwise, I have had a great deal of trouble from their cutting. Where belts are wide, of course, it is almost impossible to shift them on loose pulleys. In that case the friction clutch works satisfactorily. When it comes to electric light stations where there are a great many belts to be taken care of, if the friction clutches hang on the shaft it makes a large amount of friction. I have one case in the test of the plant, particularly on the day load, where the friction amounted to 44 horse-power, and the actual work amounted to 12. Of course, in the reports relative to the test it was advised that a small engine be put in to drive the day load direct, and that has been done, and will probably prove satisfactory.

Mr. Cartwright: Mr. President, I look at things from an experience in the mill a good many years. I got my diploma in the school of adversity, and I want to understand what this topical discussion amounts to, whether or not we are going to formulate some plan by which everything is to be accomplished by rule, so that all you have got to do is to study those rules to become an engineer. My idea is that every case requires a different prescription. Speaking of clutches: Clutches are very good in some places; and some clutches are good in some places and not worth a rush in others. Take the Hunter clutch; it is a good clutch in some places, but it requires much more lubrication in a dirty rolling-mill than in an electric light station. I have just had to do with a clutch transmitting 100 horse-power, which was very nice to throw in, but you could not throw it out when it got in there. If anybody has got a friction clutch that will answer all purposes, and run in any place, they have got a good thing, and I would like to get hold of it. The Weston clutch is a good clutch, but after it has been in operation a while you cannot throw it out. Now we have got to apply our knowledge to circumstances in different places. I think engineering is a progressive science. What is good practice to-day is poor to-morrow, and *vice versa*, and no one rule applies to these questions. I have been forty years in the harness, and I have seen a good many things tried; but to make a law to apply to everything, you cannot do it.

The President: That is quite true, sir; but do you not think that as the members give their experience under certain conditions they are giving us valuable information which may keep you and I from going through their disastrous experience? As I take it that is the idea and purport of these topical questions. Of course I am not as old as you, but you might think I was, and I want to get my diploma from the school of success, and with your permission I will say that I think that is the idea of our topical questions. The very fact that your clutch will go in and won't come out with 500 horse-power is one that we want to know.

Mr. Cartwright: There is no clutch which will cover the ground in all cases. The question asked here is what is the best design for a line of shafting transmitting over 50 horse power, permitting them to be stopped or started on any floor without interfering with any of the shafting. *You* might go and look at it and say one thing, and I might say another thing, and we all might differ honestly. There is no one law that will apply to anything of that kind. Then "transmitting over 50 horse power"—are we to have one of 50 horse-power, or one of 60?

Mr. McBride: Mr. Cartwright has got stuck on the clutch. I would suggest the belt and tightening pulleys.

Mr. Cartwright: Possibly they have had success with the belt and tightening pulleys, and for a hammer with an intermittent motion—a power hammer—there is nothing equals the tightener, because with it you get the hammer in motion slowly, and get your power as you need it; but with the electric light plant there are many considerations to be thought of. In one case we have thirty odd dynamos—every one of them is set up with a tightening pulley—a gradual putting on of the belt; and we thought we could improve on that and put in a 500 horse clutch, which clutched but did not unclutch. We had to stop the whole thing and take it all apart.

Mr. Emory: The question that is written here seems to answer itself. This asks "for the best design for a line of shafting transmitting over 50 horse-power." It should be, "Each line to be started and stopped on each floor without interfering with the motor." The only arrangement that the lines of shafting permit is the running part of the middle, or one end of the larger shafting which carries the belts to run from one floor to another, and this must run all the time; and if there is any line of shaft to be thrown in or out, it must be done by the friction clutch without interfering with the motor. There is nothing else that will do what this asks, but that arrangement; that is, it is answered already by the condition of the problem.

No. 93 was next discussed:

"IN ARRANGING CHIMNEY STACKS FOR BOILERS IS IT BETTER TO ARRANGE ONE FOR EACH BOILER, OR A LARGER CHIMNEY FOR AN ENTIRE BATTERY?"

In presenting this the president said: The reason I present this topic is I know it will be discussed by a member of our society whom we welcome back to our deliberations with great pleasure, and congratulate him upon being with us once more. I will ask past Vice-President Porter to open this discussion.

Mr. Porter: Mr. President, thanking the society very cordially for welcoming me back so heartily to health and a return to professional labor, I would say respecting this question, that some time ago—whether it is one year ago or two years ago I cannot remember—this topical question was sent to me by the kindness of the secretary and others, with a list of topical questions; and although I was not able to be present at the meeting of the society, I sent in reply a suggestion which occurred to me at the time; and in the letter which I wrote him I sent

him an original sketch (Fig. 3) which I made, which is shown by the diagram on the blackboard. In my letter I said, "Question No. 90 I regard as an important subject. Some years ago I had my attention called to an insufficiency in a battery. An arrangement has occurred to me, which, where the space required is valuable, seems calculated to mend matters in this respect. Each one of the eight boilers in the accompanying

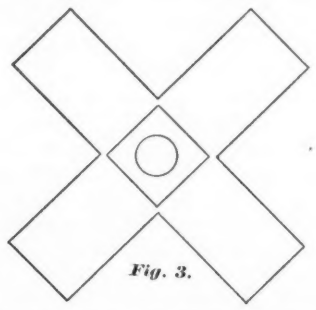


Fig. 3.

sketch must have the same draught, and that, the best draught that the chimney can give. Four or six boilers could be arranged in a similar manner, or twelve boilers could be arranged on a side. The greater cost of setting and of building would be repaid in a few months in coal saving. A large extent of wall surface is presented for the percolation of air." Of course that is a plan which has never been suggested, and I merely made the suggestion as one perhaps worth consideration in the arrangement of boilers—giving each boiler an equal chance at the chimney.

Mr Kent: My own experience confirms that stated by Mr. Porter, that when several boilers lead into one large chimney it is very apt to be the case that only part of the boilers out of the set have a perfect draught; that some of the boilers near the chimney have such a great draught that they carry the gases into the chimney at too high a temperature, and the ones further away will have such a low draught that they do not get their proper amount of evaporation, or cannot work up to capacity. I saw a case where three boilers going into the chimney exactly showed that; there was too great a draught in the one nearest the chimney, there was a correct draught in the middle boiler, and too low a draught of the boiler furthest away. The objections to one chimney to each boiler are chiefly esthetical, and possibly the cost. I think that, otherwise than as to the question of cost or the appearance of the structure, a chimney to each boiler is best.

Mr. Le Van: I would state it makes no difference where you put your boilers if the connecting flue is properly built, and it is only a question of having the connecting flue properly arranged. If the connecting flue is made of proper capacity and the inlets to that flue are properly made there is no difficulty from one having a smaller draught than the other. The question of occupying more space is not always desirable, and, therefore, I do not see that you gain anything by occupying more space.

Another member said: As the result of an examination of the Amoskeag works, in which they have some forty boilers, all connected with one stack, I failed to detect the least practical difference of draught in any one of those boilers on any sort of occasion, whether with fresh fires or old fires, or days in which the wind circulation might be stronger at one end of the boiler than the other—there was no practical difference in the draught of the boilers. The boilers were all fitted with the usual butterfly dampers, and were closed from one half to five-eighths of their capacity. They were not manipulated possibly more than once a day or once in two days. When disturbing conditions of weather arose, possibly one boiler would be a little slack of steam and they would open the damper on it.

Another member said: I should object seriously to setting boilers according to the sketch, I think, for some practical reasons. The principal one I will say is that a man has got to travel a little too far to keep track of his gauges and his water, etc. I came across some electric light boilers some two years ago. There were four—two each side of the stack, each having a pipe running up with this butterfly damper leading direct into the flue. I was in there one day, and the fireman said the boiler next the stack he had the most trouble with—both the right and left-hand boilers gave him the most trouble, and he could not understand why it was. They were fitted up the same, and it had happened that this butterfly damper was hung the same on the four, and in these two boilers, on the opening of the butterfly damper, the gases were obliged to go around that butterfly to get into the stack. The two boilers to the right were different from those on the left in the manner in which the butterfly dampers were hung. The boiler at the left and the one on the right—the outside boilers—had the damper set so that as it was opened the gas had to go around the damper, while the inside boilers were hung so that the gases went directly from the forward part of the boiler into the hole; and I told him, in my opinion, if he changed those, or changed one for experiment, he would find that there was where the trouble was—that that would explain to some extent why these two boilers next the stack did not work as well as the others. I was in there two months afterwards and he had changed both of them. He found as soon as he set them so that the gas went the shortest cut, that the work was a great deal better.

Mr. Emory; Mr. President, it seems that the office of an engineer is to settle questions exactly like this as they occur. In the distribution of water in the city it is desirable that the pressure be exactly the same, and the pipes are made larger for long distances. It is the same in the case of electrical distribution, and the same question occurs in the distribution of gases in boilers. It belittles the engineer to say it is necessary to have a separate stack for each boiler, when it is only a question of engineering to obtain the same principle of resistance in the flues in different stacks, and then the draught will be the same, and all these different questions can be answered in that way. When large groups of boilers are to be put in, a system something like Mr. Porter's is quite desirable to bring the distance of the series down to a minimum and equalize between the boilers. In single batteries the flue can be easily arranged so that the resistance will be the same from each to the stack. I have seen plenty of cases on board ship where the boilers at the outside from the smoke stack did have less draught, but in other cases, where the distance was made the same, and the uptake flues were made larger, you could not detect that difference; and in situations where they had them on a series of floors, by having the same boiler leading to different flues, although it was necessary to bring the flues in opposite, still there would be no difficulty.

Mr. Ashworth: In our system for the steel works we have batteries of boilers with flues from sixteen to twenty inches, and especially in the Beaver Falls plant, where we had twenty-eight, we have adopted a system of having a central stack. We find the draught is decreased from the boiler furthest from the center. The question has been brought before us as to the unsightly appearance of our small pipes, and it has become the standard with us to put up a large central stack and have a flue system leading to it; that is our intended practice.

Question 100 was

"WHY SHOULD ANY ONE CUT A HALF-INCH BOLT WITH 12 THREADS TO THE INCH? IS THERE ANY OBJECTION TO THE UNITED STATES STANDARD OF 13 THREADS?"

Mr. Porter: Mr. President, I can say something, perhaps, on that question. About twenty-five years ago, or nearly that, at the Plymouth Works in Manchester, I was told by Mr. Wilson, who was then the superintendent of the tool department of those works—the tool department in contradistinction from the ordnance department—that giving to the half-inch bolt only 12 threads was a mistake, and one which they had always regretted; that it cut away the bolt unnecessarily, and reduced its strength unnecessarily, and the bolt should have 13 threads. He was very frank in that statement, and told me it was a pity it could not be changed. The way in which Mr. Whitworth fell into that error—which is the only error in the system in the fixing of the thread in the Whitworth system—is a very obvious one. The English do not use the $\frac{9}{16}$ bolt; they do not know anything about it. The reduction in size is by $\frac{1}{8}$ of an inch until they get to half an inch, and below that 16ths; so that, going down, the threads increasing for each smaller bolt, we have 8 threads for the inch bolt, 9 for the $\frac{7}{8}$, 10 for the $\frac{3}{4}$ and 12 for the half inch; and that is a very natural arrangement, although the next standard is a singular one, the diameter of the bolt being reduced 1-16, and the number of threads increasing two; 12 threads on the half-inch bolt, and 14 being given to the $\frac{7}{16}$ bolt; but in this country we have always, since my knowledge of mechanics, used $\frac{9}{16}$ bolts, and that cures the difficulty at once. We have 11 threads for the $\frac{5}{8}$ bolt, 12 for the $\frac{9}{16}$ and 13 for the half-inch bolt, which corresponds with what the designers of the English bolt wished to have done, but found too late that they could not do it. While we criticise that one defect of the Whitworth system we should not overlook the fact that we are indebted to Mr. Whitworth for a uniform system of any kind. Mr. Whitworth found the system of screw threads in England in perfect chaos, every manufacturing establishment having a peculiar thread to itself, and each large establishment maintained its thread strenuously because nobody else could repair their machinery; and the problem of Mr. Whitworth was to introduce a uniform thread which would be adopted; and he told me himself he proceeded in this way, which, of course, will strike everyone as a common sense method. He obtained from every leading manufacturer of machinery his system of threads, then he averaged all these systems and adopted a system which was the mean of the existing practice, and that recommended itself to every one to be uniformly adopted. But there is another thing about the English thread too. How did it get such an impracticable and amazing feature as having an angle of 55 degrees for the thread? That is something that can be very readily explained too. Mr. Whitworth had no particular plan for benefiting the world, but a particular plan for benefiting himself. He wanted to introduce a system which would be generally adopted, but which nobody else could make. (Laughter.) And he was cute enough to solve that complicated problem very satisfactorily to himself by adopting an angle for the thread, which he stated to the world was the mean of all the angles in use; but it was a thread which it seemed possible to originate but impossible to verify or restore if it was lost, or to bisect with correctness, so that the opposite faces of the thread would have the same angle with the normal; and so we have this angle of 55 degrees, which enabled Mr. Whitworth for a long time to monopolize the manufacture of taps and dies; for cutting threads in lathes was rather unknown at that time. Stocks and dies were used for cutting threads on bolts altogether; so that the manufacture of taps and stocks and dies formed an enormous branch of the business of the Whitworth Company when I met him. But we are relieved from that feature.

Mr. Whitehead: I am very much pleased with Mr. Porter's explanation. It has always been an annoyance to me to have the 12 and 13 thread manufactured together. We have a number of customers who want the half-inch standard, and we do not know whether to send them 12 or 13; and many times in the manufacture of 12 and 13 thread nuts they are apt to get mixed, with all the care we can use. That is the great difficulty. I would like to see the 12 threads abolished entirely. I know of no reason why people stick to the 12 threads. It certainly weakens the bolt too much.

The Secretary read a communication from Mr. Dingee, in which he stated that 13 threads are probably better than 12, but many old establishments cling to the latter because they do not wish to change. He also read a communication from Mr. Webber, of Erie, stating that he did not know of any objection to using a half-inch bolt with 13 threads.

A member: Mr. President, I would like to give a very slight contribution to the History of that sort of thing that Mr. Porter described as the original incentive to Mr. Whitworth to establish a uniform system of threads in England. Andrew Campbell, who was the designer and originator of the Campbell press, conceived the same unfortunate idea that he would prevent other manufacturers from supplying bolts and nuts to his machines, and he adopted a curious system that is allowed to exist to-day. He thought he would incorporate certain threads of his own, he would adopt certain sizes of bolts that would be different from the commercial sizes; and his machines are built to-day with all those different sizes.

Mr. Oberlin Smith: I think it was that great political engineer, the late Horace Greeley, who thought that the best way to resume specie payment was to resume; and it seems to me in a matter of this kind, where we think it is best to change from 12 to 13 threads, it is best to do it. I thought several years ago that it would be a very difficult thing and give a great deal of trouble, but I made up my mind the longer I lived the worse it would grow, and the only thing to do was to change them; and I believe that would be the best policy—if an evil wants to be changed, the sooner you make the change the better, before it becomes a greater one. There is only one thing worse than getting the mean of the thread, and that is getting a mean thread.

A New Use for Aluminum.

According to a Pittsburgh dispatch, an order for five hundred tons of aluminum has been placed with the Pittsburgh Reduction Company, to be used for the equipments of the German army. Capt. Hunt, of the Pittsburgh company, is reported as saying: "The emperor desires the canteens of his soldiers to be made of aluminum. There are two reasons for this, namely: its lightness and cleanliness. It will be used also for buckles, and it may be brought into use in the manufacture of cartridge shells. The new smokeless powder cartridges have brought about a demand for aluminum, and other European powers are also considering the advisability of using it."

The Yorkshire Boiler Insurance Company of Bradford, Eng., send us a copy of Mr. John Waugh's report on the explosion of an upright boiler at Huddersfield, Eng., on June 3, 1891. The boiler was internally fired, and a hammer test was applied to it (not by the Yorkshire company, however), on June 2d, the day before the explosion. Next day, the fire box collapsed, killing one man and injuring several others. The rupture revealed the fact that for a distance of six to eighteen inches from the bottom of the fire box, corrosion had eaten the plate away round the whole circumference of the boiler; in some places, about 13 or 14 inches from the bottom, to the thickness of $\frac{1}{16}$, the original thickness being $\frac{7}{16}$ of an inch.

This explosion is an excellent illustration of one very important fact, which is, that the hammer test, to be of value, must be applied by a man who has had long experience in such work. A novice might pass over a very dangerous spot with the hammer, and not detect it; while, on the other hand, we have seen experienced inspectors detect flaws with the hammer where the novice could perceive no difference in the sound. We do not recommend the hammer as a substitute for thorough internal and external examination, but it is very valuable when applied by an experienced person, on boilers that cannot be thoroughly examined in any other way, either on account of their design or their small size; and we believe in applying it on every occasion, in *addition* to the regular internal examination.—*The Locomotive.*

It is asserted that at Gibraltar the human voice has been heard at a distance of ten miles.

A Communication from the Phoenix Iron Works.

It having lately come to our notice that some builders of tandem compound engines are copying our construction and design, we deem it no more than proper to give notice that this improved construction was patented November 18th, 1890, and is the exclusive property of this company, and that we shall protect our rights as against all builders or users of engines.

The "Dick & Church" tandem compound engine, as built by us, was illustrated in the AMERICAN MACHINIST in the issue of September 24, 1891, in which was shown cuts of the engine, together with a full description of same. The advantages of this construction, as against any other known design, are manifest, and others, as well as ourselves, evidently recognize it, but we trust this will be sufficient to prevent any further acts of piracy; at all events we have endeavored to protect the general public by publishing this notice. It is our good fortune to own this design for tandem construction, and we suggest that other builders who recognize its important advantages should at least have the courtesy to write us before making use of it, no matter whether they propose to use an exact reproduction, or merely copy as near as they think will be safe and evade our claims. We should like them to at least do us the honor of letting us have the credit of possessing the merit of originality.

PHOENIX IRON WORKS COMPANY.
Meadville, Pa.

Improved Grindstone Frame.

The accompanying illustration is of a grindstone frame recently brought out by Mr. W. P. Davis, of Rochester, N. Y.

The frame, with the exception of the legs, is cast in one piece, so that there are no joints to be looked after, and the top is of such form that water from any part of it will flow back into the reservoir. The rest is placed sufficiently above the frame to admit of work of irregular form being ground without coming in contact with it, and so that grinding can be done on the side as well as the front. There is a sleeve which passes over the arbor, one of the flanges being cast solid with this sleeve and the other slipping over it and being tightened by a nut. By this construction the stone can be adjusted, trued up and then put in place on the shaft. The driving pulley is 20″ diameter, 5″ face, and will carry a stone 42″ diameter, 6″ face.

Charles Miller, of Washington, Mo., writes us in reply to Mr. Bullock's call for a pipe cutter that will cut pipe without burring inside or outside, that he makes such a cutter, the utility of which has been thoroughly demonstrated.

LETTERS FROM PRACTICAL MEN.

Some Observations on "Proportion in Steam Engines."

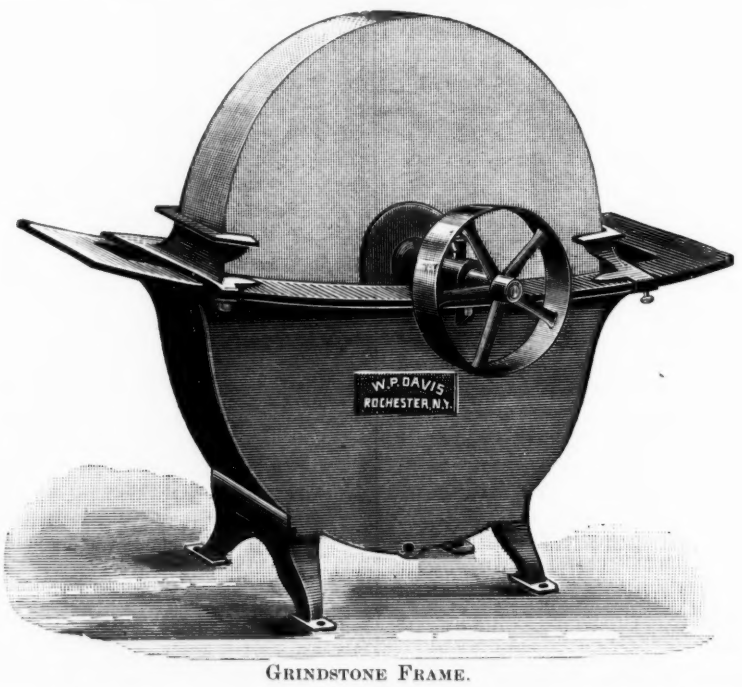
Editor American Machinist:

I would respectfully call attention to some erroneous conclusions that I think your correspondent, Mr. F. W. Clough, has arrived at in his communication under the above heading, in your issue of Oct. 22, 1891, by being prejudiced in favor of short stroke engines.

Among other things, he says that a locomotive with 18″x22″ cylinders and 68″ wheels had fully one-fourth greater capacity as a freight engine than one of like weight on drivers, but had cylinders 16″x 26″ and 60″ wheels, and attributes this extra efficiency directly to the proportioning of the areas and stroke of the pistons. From this, and an example from marine engineering, he devotes a paragraph to what he would do if a master mechanic, closing it by saying that "the mechanical and steam world are plunging in that direction."

The fact that one of the latest and fastest locomotives in America has cylinders 24″ stroke, and the heaviest locomotive in the world has cylinders 28″ stroke, would seem to contradict this, at least so far as locomotives are concerned, and the record of the Corliss engine for power and economy will arrest the "plunging," so far as stationary engines are concerned.

As long as space is scarce, short stroke engines will be in demand. But let us drop sentiment and return to the facts and compare the two locomotives, the one with 16″ x 26″ cylinders and 60″ wheels with the one with 18″ x 22″ cylinders and 68″ wheels. It may be well enough to state that the weight on the drivers determines the amount an engine will pull, provided the cylinders have capacity at all times equal to the "adhesion" of the drivers. It is not probable that an engine, because it had 68″ drivers, would have any more "adhesion" than one having 60″ with the same weight, so it will be seen that if the same force is applied to slip them, each engine should pull the same amount. We will next see what difference there is, if any, in the force that is applied to the wheels by the different cylinders; and, as there is nothing said to the contrary, we are allowed to suppose that both engines are in like condition, that the tires on the driver are of the same material, that the steam pressure is the same, that the engineers are equally proficient, and that all other conditions are equally favorable for one as the other, except the cylinders. If the engines are not in like order the extra efficiency of one cannot be attributed to difference in the proportion of the cylinders. The mean tractive force of a locomotive in pounds is theoretically found by multiplying the area of the cylinders in square inches by the stroke of piston in inches, and dividing by the diameter of the drivers in inches. This will give the tractive force in pounds for one pound average effective pressure per square inch on the piston. Applying the rule to the old engine we have $\frac{201 \times 26''}{60''} = 87+$ pounds tractive force for each pound average effective pressure for one side of the locomotive. Applying the rule to the new engine, we have $\frac{254.5 \times 22''}{68''} = 82+$ pounds tractive force for this locomotive for each pound average effective pressure. In order for this engine to pull one-fourth more than the old 16″ × 26″, it should have a tractive force of 108 pounds for each pound average effective pressure, and must have exerted, owing to a better distribution of steam, due perhaps to an improved valve or valve gear, or to a higher boiler pressure, or a combination of all these and other favorable conditions, which was likely the real cause of the difference in the two locomotives.



GRINDSTONE FRAME.

Some practical lessons from Mr. Clough's pen, illustrated with indicator cards, showing where a gain of 25 per cent. can be made by changing the 16″ × 26″ proportions any way, will be very interesting reading.

I do not think he will have any trouble in finding engine builders who will guarantee as much power from a 16″ × 26″ engine with a 60″ pulley at a given velocity as he can get out of an 18″ × 22″ with a 68″ pulley at the same velocity, boiler pressure, etc., and say nothing of about 25 per cent. in their favor.

Facts, experiments, theory or practical suggestions backing such statements as Mr. C. makes, ought not to be kept "under a bushel."

Such statements, "as every engineer knows," are not relevant in the sense he uses them, neither does comparing the piston speed of one engine with another prove anything unless some reason is given why it is favorable or detrimental. C. O. SINE.

More About Steel.

Editor American Machinist:

The very interesting and suggestive communication of Mr. Severance, which appeared in your issue of November 5th, leads me to write a few more words about steel.

That to treat the subject as though steel was simply steel, no matter of what quality, grade or temper, would be misleading, mischievous, even, I am ready to agree with Mr. Severance is true. But to the suggestion of a possible or probable way out, through a "short, comprehensive treatise classifying according to prices," I see some objections. A very little investigation among successful steel consumers will show that for identically the same uses different steel workers are using steels which vary in price in the proportion of from two to even three or four to one; and still, in the matter of service, amount of work performed, durability of tools, those who use the high-priced steel cannot show any better record than their neighbors who are using steel costing from 25 to 75 per cent. less than the high-priced fancy brands thought in many shops to be indispensable.

What significance would the question of price have as applied to any particular grade or quality of steel unless temper and carbon percentage were taken into account? Suppose steel is wanted for any particular use, and it is found that some bearing a certain brand, and costing a certain price, is just the thing; does it follow that more of same brand, at same price, will answer the purpose equally well? We know how often it does not, and then comes the cry, "lack of uniformity," *when the fact may be that the grade, the quality, is strictly uniform*—the lack of uniformity being only a difference in temper, in carbon, from that which had proven just right; but while this particular temper may not be right for your use, my friend, it may be exactly right for somebody else.

Now, just here I expect to be brought up with the questions, "Why not make it all alike?" 'Why not give us steel which will be found equally well adapted to all the uses to which steel is put?" "We want steel out of which we can make anything, everything. Why must we be told that for different uses different steels and different tempers are needed?"

Answers: First. It could not be made all alike, even if it were best. Second. No one temper of steel can possibly be equally good for all uses. Third. Because your own practice and demands upon the steel manufacturer call upon him to furnish different grades, qualities and tempers, each suited to some particular use.

Do I know that I have put my foot in it now? I know this. Many who will read the above will say: "Goodyear is away off. Don't we use ———s' old reliable steel, good old English stuff, for everything? We use it for dies, lathe tools, cold chisels, etc., etc., and it is all right for all uses to which steel is put." Very well. Now, for every man who corners me with that statement I think a dozen can be brought who will say, "That is what we used to think, but when we found that for some of the most difficult work, in some cases work which our old favorite steel would not do, we could get from domestic manufacturers steels especially adapted to the work which would do twice or even four or five times the amount of work we had been doing, and not at fancy prices, either, our eyes were opened. Now we take the steel manufacturer into our confidence and tell him what we expect to do with steel; we have thrown aside the belief that steel has any 'fixed or universal' value as steel, unless it is of such quality and temper as fit it for the use to which it is to be put."

But enough of this for this time. Let us come to "the branch of the trade which has been shrouded in mystery, as the 'art' of annealing, hardening and tempering." "Art?" Yes. "Mystery?" No. That many successful steel workers invest their operations, especially those connected with hardening and tempering, in much mystery, is true; but it is at the same time true that others who are just as successful are ready to tell the "young mechanic" all that they know about the matter. It is very simple. Annealing depends simply upon gradually, evenly heating steel to about the same heat at which the steel could be hardened to put it at its best, and then compelling it to cool off slowly. Hardening depends simply upon heating to the right heat and suddenly cooling.

This brings us to the comments upon language used by me to express the idea that, after all that the steel worker, especially the steel hardener, can learn from books, or newspaper articles, or from others, it is the steel itself to which he must look to learn whether his treatment is right or wrong. If in annealing steel of fine, even grain, you change the grain to a coarse, uneven condition, the steel should say to your understanding, your mental consciousness, "You heated me too hot"; again, if in hardening, the steel, instead of being refined, as it should be, should be found to be much coarser than before hardening, or even should be found no finer for the hardening, it ought to be understood to say again, "Too hot."

Right heat at which to harden steel? Certainly, with pleasure. It ranges all the way from a dark red up to a "nice lemon yellow," for steels of different tempers, and for pieces of different size of same temper. How shall we know how hot to heat any particular steel? Try it. Heat and harden a piece and break it. If you don't hit it the first time, try again, and when by hardening you have produced a grain as fine as flint, and have the piece thoroughly hardened, you have learned what that steel wants. Steel talks, if we will but learn its language. But here is a long scrawl, and I have not come to the point and stated what, after objecting to the plan proposed by Mr. Severance, I would recommend as a substitute for getting the right steels for the different uses into the hands of steel users. Here it is: Go to good reliable men who know by their own experience, and by that of their customers, about what is wanted for all the different uses to which steel is put, and state just what you want steel for. Let's put one

"don't" in this letter. *Don't*, above all things, think you can tell by looking at the grain of steel what its character will be when worked into tools and hardened. Fine grain or coarse grain in ordinary steels signify simply a condition dependent upon heat and working. Hardening at proper heat brings the fine grain to coarse and fine steel alike, even to ingot steel, or to steel castings. High heat brings coarse grain to the finest steels.

Now, about taking pieces out of the quenching bath before thoroughly cooled. Warming up the outer portions must expand them. Antagonistic strain there must be with the outside cold, or nearly so, while the inner portions are still quite hot. To expand the outer portions, then, must relieve the strain. In my letter of October 8th I am made to say, "*Don't* refuse to buy it," referring to this very matter. "Don't refuse to try it," I said; and as to its being successful with some steels and a dangerous thing to do with others, I disagree with Mr. Severance again. The greater the danger of cracking in hardening, the greater the benefit from doing just what Mr. Severance thinks would be so disastrous. Is twenty or thirty, or down to ten per cent. a large proportion of imperfect work from hardening as practiced by many steel users? "I wanted nine of those pieces, and to get them I made and hardened twenty-nine," said a steel user to me not long since. "In the steel?" Granted, at just the treatment it got. Now, as to case-hardening. As to a piece being hard outside and soft within, as a result of taking it out of the bath before thoroughly cooling. It will only be a shell, which will be hardened anyhow. No piece of any considerable size can be hardened to a depth of even a quarter of an inch. I mean *hard*, so that a file or chisel will not take hold. To those who talk so confidently about "hardening big pieces, dies, *clear through*," I have to say, go at the inside of some broken die, and if you find, *and you will*, that it can be filed, drilled, if you please, don't lay it to some peculiarity in that particular steel. It's the universal law, just because we cannot quench "*evenly*" and "*quickly*" enough to produce any other result. At proper heat, and suddenly cooled, the piece of steel, of say 1-inch cube and larger, will have a hardened shell formed upon it, which will get no harder or deeper by staying in the bath until cold. The inner parts do not harden, simply because the heat is conducted from them too gradually. If the entire mass could be cooled at once? Yes, but how?

S. W. GOODYEAR.

Phenomenon in Shrinkage.

Editor American Machinist:

I see by your issue of November 12, two gentlemen—Mr. Frank Richards and Mr. Alex. Cairns—give their versions of the cause of the "Phenomenon in Shrinkage" that I stumbled over a short while ago. Both gentlemen, though widely separated, seem to have arrived at about the same solution, that is, that it was heated at the center first. In this they are wrong. As I personally attended to this piece of work, I think I may be able to give all the details, but will say this: we have built a good many high-speed engines, and have always put the pistons on in this manner, and have never had any trouble with them. In this case we took one of our regular patterns and lagged it up to get the right size to suit the cylinder sent in to be repaired. It may be possible that this additional metal had something to do with it. It is well known that, if a hole is bored in a piece of wood, and water poured into it, the hole will get smaller; so if heat is poured into a hole in iron the hole will get smaller.

Some few years ago one of our workmen was given a 28" gear wheel to fit on a $1\frac{15}{16}$" shaft of cold rolled iron; he calipered the shaft, and bored to a caliper fit. After taking from the lathe he found it too small, so thought he would heat it; he put it over the forge fire, and began to heat the hub. Pretty soon the hub began to get hot, but he says the hole did not get larger. More heat was applied, when suddenly, with a loud snap, the rim parted, and the crack was nearly $\frac{1}{4}$" wide; the hole was big enough then.

Well, with such experiences to guide, this casting was put on the forge, fire built up all around it, and heating begun. It was turned over several times to keep the heat uniform. We were very careful to heat the outside first as near as possible, and had to watch the edges so they would not get too hot, and "burn off before she got hot" (we've been there). We avoid, as much as possible, letting the blast go up through the hole, as green coal will get in, and is very difficult to get out while hot.

Mr. Richards says that I probably poured water on it to cool it; this I would not dare do with any kind of shrink fit. Sudden cooling will either cause the metal to set in its expanded state or cause such a sudden contraction as to burst it. Water is an enemy of shrink fits. I can readily understand the case of the pieces of steel he mentions.

Mr. Cairns handles the case very intelligently, but, unfortunately, from a point that we avoided. We did heat over a blacksmith's forge, but we did think of the effect of heating the center first, etc. His theory will apply very well where the conditions he supposes are followed.

After careful consideration I am convinced that my first theory is right. The cores being hard, dry sand cores, the metal completely surrounding them, they did not allow the metal to shrink uniformly, with the resulting tension. We build some small vertical engines with a pear-shaped frame; the smallest pattern (5 H. P.) requires a dry sand core, the majority of them come to us somewhat longer than desired—nearly as long as the pattern. The molder thinks that the core prevents the casting from shrinking properly. We know that the arms of wheels and pulleys and light parts on heavy castings shrink, so that the tension will sometimes cause them to crack. But after all, I am open to information on the subject; for, had I seen through the matter at first, I would not have asked for light.

SAMUEL T. WILLIAMS.

Ball Bearings.

Editor American Machinist:

When Mr. Purcell Taylor asks for some one to demonstrate the mechanical absurdity of ball bearings we may conclude he refers to two things particularly.

1st. To the fact that balls are only theoretically fit to run between flat or cylindrical surfaces, and that they can as a consequence only have, theoretically, a mere point of contact or bearing surface, and, therefore, only a very short life.

2d. That if run in semi-circular grooves, there must be a lot of rubbing friction, seeing that at different radii the ball tends to roll forward at different speeds, and there must be rubbing at all save one radius.

Were we to carry out this style of reasoning in all matters, we should have to condemn the Stephenson link motion for valves, for it is notoriously unmechanical, and only made passable by the introduction of other faults of opposite kind from those natural to it.

The Watt parallel motion, which has done such good service in thousands of steam engines, is not by any means a straight line motion, and yet it is good enough to be better than others which are mechanically accurate, and is even applied to so delicate an instrument as the indicator.

Ball bearings come under the same category, and, though mechanically imperfect, I shall continue to use them so long as I find they are superior to anything else—superiority here including the utilization of a small available space.

In my own practice, which ranges from spheres of $\frac{5}{16}$" to $\frac{3}{4}$" diameter, I find it sufficient to turn the grooves in which the balls run, very slightly larger than the balls, and quite considerably larger at the diametral line.

When first set to work, the balls seem to bear on a narrow band of $\frac{1}{32}$" to $\frac{1}{16}$" wide, and after some wear and weight they attain to a wider bearing.

If they became completely bedded I would return the grooves; but the plain common sense of their use is that, quite apart from any question of durability, they give me the means of carrying out certain operations which would not otherwise be possible, and they further put into the range of power of a man what would require two men to do without them.

They can be used in places where the Grubb ring is wholly inadmissible. That is well enough on bridges and turn-tables generally, but altogether too bulky for machine uses.

For cylindrical bearings the roller bearing which preceded the ball bearing in bicycles seems more perfect, but I am told it is not better in practice, and no doubt where pressures are moderate, and both balls and bearings hard, these will prove best.

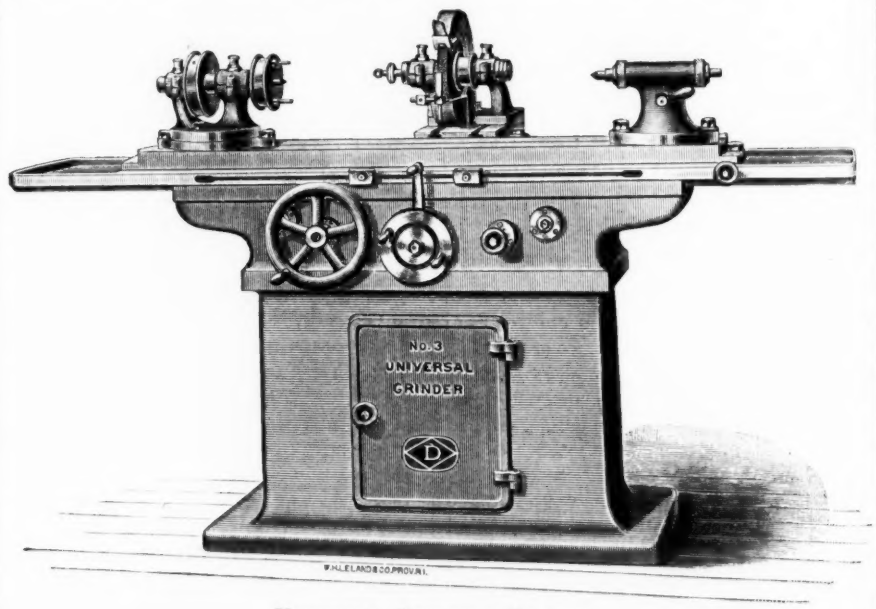
In a bearing recently made for 50 tons with 96 balls, a mistake in the turning deprived more than half the balls of any load whatever, and one circle of balls only took any weight, and are very little affected by a test of probably 20 tons, though the bearings are only as soft as wrought iron.

There are innumerable contrivances known to practical men, besides the two glaring examples which most readily suggested themselves to me, which cannot be defended on the score of their mathematical truth, and yet without them engineers would be seriously hampered in many ways, and large quantities of machinery would be made needlessly cumbrous if more perfect devices (nominally) were employed; and so it is with ball bearings, my own experience of which is that they should be kept clean, especially when new, and whilst they are adjusting their weight to their breadth of path. During this operation there may be abrasion, but as the path broadens this ceases, and I look on an angle of 30° as a fair proportion of the circumference of the balls to be in contact, whilst I find that a convenient amount of free space in any ring of balls is that represented by putting in all that are possible, and removing one. I thus never have a spare space as much as two diameters.

Every ball which carries a load must advance at one speed, and there can be no friction between the balls themselves, whilst if any ball is out of contact, through being small in diameter, it merely requires pushing round by the one next following.

At the same time, ball bearings shall have no countenance from me, as soon as a better substitute is forthcoming. It will not do to dogmatize on any subject of engineering or mechanics.

W. H. BOOTH.



UNIVERSAL GRINDING MACHINE.

Universal Grinding Machine.

We present with this an illustration of a universal grinding machine made by the Diamond Machine Co., Providence, R. I.

The machine is designed for grinding cylindrical or taper work upon centers, both of which may be dead if desired, the rear center being held to the work by a spring which allows for expansion during the grinding. The table swivels for tapers up to 2" to the foot, and the head stock swivels to any angle for grinding holes in work held in the chuck or on a face-plate, or for facing. The cross-feed can be made automatic if so desired. All spindles are of steel, ground true, and run in bronze bearings, which are provided with special devices for excluding emery dust.

The machine will swing between centers 12" diameter and 30" long, the table having a traverse of 30". The diameter of emery wheel used is 12", and the floor space required is 40"x115". Weight of machine and countershaft, about 2,800 pounds.

The Meriden Machine Tool Company, of Meriden, Conn., are distributing among their friends some very neat salt and pepper bottles for use on the table, the tops of these, which are very nicely finished and gold-plated, having been finished ready for plating on one of their forming lathes. Accompanying the bottles there is a circular which graphically illustrates in an original way the shop room saved by the use of their lathes as compared with some of the more commonly used tools.

That the forming lathe and other tools built by this company are proving popular is shown by the fact that a new shop is to be built as soon as possible, in which they will have increased room and facilities for turning out work.

"While I was in England," says one woman, "I was told of an American, who, on his first trip on an English railway, quite held his breath at the rapid running. When his nervousness rather overcame him he approached the guard.

"'I say, guard,' he ventured, 'this is pretty fast traveling for safety, isn't it?'

"'Oh, no, sir,' replied the guard; 'we never run off the line here, sir.'

"'But,' said the Yankee, quickly, resenting the patronage, 'it is not the line; I'm afraid of running off your confounded little island.'"

The railroad interstate commerce commission, which has now under advisement a report to congress for uniform cars and railroad appliances, has been stimulated to action in this matter from the fact that an average total of 6,000 killed and 26,000 injured railroad employes in the United States is too large a number, mostly from preventable causes, not to make it a national affair. A quarter of a million dead and wounded every ten years is a direct charge upon the country that ought to be avoided.

Thomas Towne, who has for some time been connected with the buying department of the Garvin Machine Co. of New York, has accepted a position with the Union Drawn Steel Co., Beaver Falls, Pa., as eastern sales agent. His office will be in Electrical Exchange, Liberty and Washington streets, New York City.

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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Engineers Society Matters.

The unanimity of the vote at the recent meeting of the Mechanical Engineers, in the matter of increasing the dues and initiation fees, is perhaps the very best evidence that could be presented as to the value of the work the society is doing, and the appreciation of that work by the members. It is generally conceded that the affairs of the society are excellently well managed, and in fact it is frequently held up as a model society in many respects, both in this country and abroad.

To Secretary Hutton must be given the principal credit for this, of course. He approaches very closely to the ideal secretary, and we know of no way in which his administration of the affairs of the office could be improved. But even the ideal secretary could not secure so great a measure of success for a society in which the members themselves did not take an active interest, and the members themselves, we think, have reason to be proud of their part in the work of building up a society which is, and which seems morally certain to continue to be, not only very creditable to the profession, but extremely useful as well.

Reference has been made to exclusiveness in connection with the raising of the cost of membership, but it is very certain that no such motive had anything at all to do with the matter. It was shown conclusively that membership was worth more, and that unless members paid more some backward steps would have to be taken, and, in strict accordance with the spirit of American mechanical engineers, it was decided not to take any backward steps, but rather to go forward.

Those who did not attend the meeting, and consequently did not hear the discussion upon the matter of requiring the nominating committee to place the names of two candidates for each office upon the ballots, may be surprised to learn that the proposition was defeated by a unanimous vote, but the fact is that there was no one present who had anything to say in favor of the change, while those who spoke against it showed that, if the committee desired, they could, under ordinary circumstances, secure the election of any candidate selected by them, simply by placing in nomination with him the name of a member unknown to others, or manifestly unfit for the office; and that, should factions grow up in the society, a majority of the committee could always control its action, while under the present plan any five members who, for any reason, might be dissatisfied with a nomination, could place a candidate in nomination, and upon demand have his name put upon the regular ballots without any marks by which it could be distinguished from the regular nomination of the committee.

Several members also gave their experience in other societies, in which a plurality of candidates at every election resulted in electioneering, wire-pulling and other work, not conducive to harmony, nor consistent with the dignity of such a society.

As at present arranged, the door is wide open for any who desire to contest an election with any regularly nominated candidate, and upon precisely equal terms, and it seems to be the general opinion that that is sufficient, and, in fact, about all that can be well provided for.

Grinding in American Workshops.

Last week we published an abstract from an address read by Mr. Hans Renold before the Manchester Association of Engineers on the subject of American Workshops, in which, among other things, he said something about the practice of grinding cylindrical work to size here instead of turning it. As might be expected, Mr. Renolds' paper has been vigorously attacked, and the opportunity has been made use of in some quarters to refer to the Americans' wicked propensity to brag, it being especially painful to the British mind to discover that Englishmen coming over to this country, and seeing how things are done here, are in many instances convinced that what has been regarded simply as extravagant boasting is, in many cases at least, little if anything more than a plain statement of facts.

It seems that Mr. Renolds' paper in some way gave the impression that it was almost the universal practice in this country to finish cylindrical work by grinding, and that work finished to size in the lathe was the exception—an impression which, of course, is very far from correct. A most ludicrous reason was given for this imaginary universal practice here by "a leading machine maker," who, in discussing the paper, said, according to the report in *The Mechanical World*, "That the reason why grinding was resorted to in America was the American workman could not size a shaft as delicately as an English operative, and consequently, after the shaft had been turned to a certain size, it had to be handed over to the grinder to be completed." As a specimen of English bragging this is delightful, especially when we remember that precisely the same means must be used in gauging the size of work for making fits, whether the finishing be done in the grinder or in the lathe. Do our English cousins suppose that American grinding machines automatically fit work correctly, and that when using them there is no further need for calipers and gauges or skill in using them? If they do think this we are in candor compelled to acknowledge that our grinding machines have not yet been brought to that state of perfection, and that in our opinion they never will be; but that, on the contrary, it is now and will continue to be the case that more skill is required in calipering and gauging work when ground than when turned, for the simple reason that the work produced is more nearly true and round, and accuracy of fitting must always bear a pretty close relation to accuracy in other respects—a fact which most practical men are thoroughly familiar with.

It seems a little strange that, after the very liberal expenditure of money to increase the water supply of New York City, there should still be a lack of water. If there is lack now, what will be the case ten years from now? Then there is plenty of grumbling in regard to the quality of the water. Water ought to be cheap and plenty in all large cities, and when reaching out for a new supply every effort should be made to provide for future growth in population. In this great country an adequate supply of good water is a question of dollars and cents only, and the plan that gives the best and purest supply is likely to be, in the end, the cheapest.

"Why does not," says the *Sun*, in writing on this subject, "Commissioner Gilroy reduce the supply of water to some of the large manufactories in the city?" Why not, to be sure, and so drive them from the city, with their workmen and those dependent upon them?

Until recently New York was the greatest manufacturing city in the country. But if there is one thing more than another that manufacturers require, it is a plentiful supply of good water at a cost that does not bankrupt them. When this cannot be had they will, in self-defense, go elsewhere.

The London correspondent of the New York *Times* calls attention to the fact that the Chicago papers of the 24th ult. printed the report of the two delegates deputed to visit Chicago on matters connected with the World's Fair as though it were made by Sir Henry Wood alone, whereas, as a matter of fact, James Dredge, the editor of *Engineering*, was the principal person responsible for it and wrote most of it, Wood being merely a paid secretary. It is said that they even went so far as to change the reading all through by substituting "I" for "we." It is charged that this was done for the purpose of offering an affront to Dredge, to induce him to resign, as he is a man who cannot be "used" or handled by those in authority at Chicago. We do not, of course, know just how much there may be of truth in all this, but we are very confident that the interests of the show will be very badly injured by allowing anything which has the appearance of being inspired by any such motives. Possibly this matter has been explained to the satisfaction of Mr. Dredge, but we have seen no explanation of it, and it would seem that an explanation would be in order.

At this time of year, when winter is beginning to tighten its grip, comes in the workings of one of the hardest gripping monopolies to be found in the world—the monopoly of the railroad and mine owners to keep up the price of coal. Only so much must be mined or transported, lest the price shall fall to an extent that poor folks can keep warm. Of all monopolies the coal monopoly is the worst. Nature has been bountiful in respect to providing the possibilities of heat, but monopoly steps in and pretty effectually annuls the work of nature. It is small wonder that the people object to a few companies holding in their grasp the right to the use of what ought to be as free as it can be made.

We understand that in St. Louis an organization has been formed whose object is the development of new ideas and the encouragement of inventors and men with patentable ideas, but lacking the means to place them before the public. The officers are: J. M. Sherman, president; E. F. Kelly, secretary; and E. O. Bartholomew, treasurer. Ladies will be admitted to membership in the club. Each member is to pay $1 as initiation fees, and another dollar as annual dues, while also incurring the additional expense of 6 per cent. on the outlay which secured a patent.

The difficulty of regulating the ordinary affairs of life by statute is being shown rather conclusively in Cleveland. A law was passed fixing the price of gas at a low figure, and to get even the gas companies have made the quality of gas to correspond. Now the authorities are after the companies in the way of testing the gas furnished. And so the fight is likely to go on.

The Pennsylvania Railroad will soon have in active service five heavy compound freight locomotives of the Vauclain type. If their performance is superior to that of simple engines, it is expected that a large number of the same type of engines will be used on the road.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(509) G. N. V., Bayonne, N. J., writes: Kindly let me know in what number of the AMERICAN MACHINIST you have published an article relating to slow-burning building construction. *A.*—December 12, 1889.

(510) W. P. M., Sterling, Ill., asks: Please let me know through your columns if any one thousand horse-power boilers have been built. *A.*—Yes; boilers as large as 1,500 horse-power each have been built. 2. Are there any boilers of that size in Denver, Col.? *A.*—We do not know.

(511) C. T., Boston, Mass., writes: Please inform me if a valve gear, which will open the ports to a wider extent at early cut-offs than is now done with the link motion on a locomotive, is worth a patent. *A.*—If it possesses the simplicity of the ordinary link motion, and is as reliable, it may be worth while to have it patented. Simplicity and reliability are some of the important features in locomotive construction.

(512) J. P. T., Jackson, Mich., asks: Have Mr. Meyer's articles on Modern Locomotive Construction appeared in book form? And, if so, what is the price? *A.*—The articles, with much additional matter, are now

in the hands of the publishers (John Wiley & Sons, New York). The book will probably be for sale about the beginning of January. Due notice of its publication and price will be given.

(513) H. B., Portsmouth, Va., writes: Please inform me which is the best book for an apprentice to the machinist trade to study. *A.*—See "What to Study and How to Study," in our issue of February 19th, current volume. 2. From what book can I learn drawing? *A.*—We believe the articles treating on practical drawing, recently completed in the AMERICAN MACHINIST, will aid you.

(514) J. B., Kearney, N. J., writes: Kindly inform me through your columns if a true ellipse can be struck with a trammel without changing the centers. *A.*—Yes, provided you use a trammel made for the purpose. An ellipse can also be drawn by means of a string attached to two points called foci, which we understand you to call centers, and these points are not changed for an ellipse in which the major and minor axes remain unaltered.

(515) F. S. W., Denver, Colo., asks: At what temperature has wrought-iron the greatest tensile strength? *A.*—This is a matter of doubt, and will require more experiments for a satisfactory conclusion. Experiments that have been made indicate that wrought iron has the greatest tensile strength at a temperature varying from 325 to 395 degrees Fahr. 2. What percentage of clearance is usually allowed in modern high speed engines? *A.*—From 4 to 10 per cent., sometimes less.

(516) A. T., Olney, Ill., writes: Please inform me what is the largest per cent. of air space in grates, and where can they be obtained? We desire to get a set with a very large per cent. of air space. *A.*—The air space depends much on the rate of combustion and the character of the fuel; sometimes 50 per cent. of the grate surface is allowed for the air space. It is doubtful whether you can find grates in stock which will answer your purpose. The best way will be to have patterns made, and the grates cast in any foundry in your locality.

(517) C. A., Brooklyn, N. Y., writes: I am practically and theoretically well acquainted with the design of boilers, steam engines and general machinery. I desire to acquire a more special knowledge in hydraulic machinery, especially pumps, and would like to take lessons of a specialist. Can you name some one to whom I could apply? *A.*—Inquire of some of the professors in technical schools, or in the evening schools, of which there are a number in Brooklyn; or you may do well by writing to the Cooper Union, New York.

(518) F. M., Wheeling, W. Va., writes: Please refer me to back numbers of your paper in which marine engine valve gears are described or illustrated. *A.*—Marshall's valve gear is described and illustrated in our issue of July 18, 1889, and Joy's valve gear is described in the Question and Answer columns in the issue of November 13, 1890; its application is shown in the illustration of the engines in the ferryboat "Cincinnati," described in our issue of November 12, current volume. The manner of laying out the particular kind of valve gear to which you refer we expect to give in the near future.

(519) G. D. N., Charlestown, Mass., writes: I am thinking of designing a triple-expansion compound condensing engine, cylinders 6, 10½ and 15½ inches diameter and 10 inches stroke. I would like your opinion in regard to the points of cut-off in each cylinder. I have looked the matter up in books, but have not been able to come to any satisfactory conclusion. *A.*—We should set the valves to cut off at .4 of the stroke in each cylinder, and make such slight changes afterwards as the indicator cards may indicate. In some designs of engines these changes can be made while the engine is running.

(520) F. A., Killingly, Conn., writes: I would like to have you send me one of your receipts for hardening cast iron so that it will not wear fast, and cannot be filed. I would like to do the hardening by heating the cast-iron and dipping it into a liquid. I am willing to pay you for your trouble. *A.*—You can harden small castings by heating them to a cherry red, applying potash and dipping them in water. You may lose one occasionally by springing, but, with reasonable care and avoidance of overheating, the loss will probably not be great. We accept no compensation for answering questions.

(521) H. S., Cedar Keys, Fla., writes: Please inform me how many holes ¼ inch diameter are equal in area to that of a hole 2 inches diameter? *A.*—The area of a hole ¼-inch diameter is .049 of a square inch; the area of a 2 inch hole is 3.1416 inches; hence $\frac{3.1416}{.049} = 64.1$, or, neglecting the small fraction, we may say that the combined area of 64 holes ¼ inch in diameter is equal to the area of a 2 inch hole. If a liquid is to pass through them we should add 25 per cent. to the number of small holes, and use 80 in place of 64.

(522) W. B., Chicago, Ill., writes: Please give me a list of the various licenses or certificates of competency to be obtained in this country relating to electrical and mechanical engineering; where the examinations take place, and the fee required for each. I want to get all the licenses my knowledge of the science will admit of. *A.*—The only certificates granted for competency in electrical and mechanical engineering are the diplomas given to graduates of institutions in which these sciences are taught; and, of course, the examinations take place there. For the tuition write to any of these technical institutions, of which there are quite a number in this country. It seems to us that, after you have gone through a course of instruction and obtained one diploma, you will be satisfied, without seeking to obtain others

(523) M. B. & R., Bay City, Mich., write: We have three tubular boilers 5 x 16 feet; please let us know what size heater will be required, also size and number of tubes. Also please give rule for finding the size of heater for any size tubular boiler. *A.*—No rule that will answer in all cases can be given. The best custom is to allow one square foot of heating surface per horse-power. This amount of heating surface may have to be modified to suit given conditions. We should use tubes two inches in diameter. The total heating surface in the heater is equal to the product of the length in feet of tubes into the circumference in feet of one tube into the number of tubes. Hence, to find the number of tubes, first decide upon their length, then divide the total heating surface in square feet by the product of the length and circumference of the tube, all in feet; the quotient will be the number of tubes. Make the length of tubes as great as is convenient.

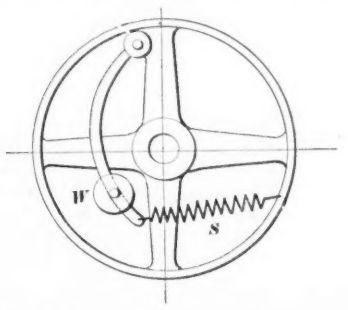
(524) J. F., St. Louis, Mo., writes: I have a $2\frac{7}{16}$-inch shaft driven by a 24 inch pulley from a 24-inch pulley on line shaft transmitting about 15 horse power. I wish to add machinery which will require about as much more power. I wish you would answer in your columns the following question: Can I double the power of the $2\frac{7}{16}$-inch shaft by doubling the size of both the driver and driven pulleys? I will add that I have plenty of engine power. *A.*—With an increase of the diameters of the pulleys, and without changing the speed of the shaft, a greater power may be transmitted from one pulley to the other, but whether the shaft can transmit this extra power will depend upon its speed, of which you have said nothing. The horse-power which an iron shaft can transmit is generally found by the following formula:

$$H = \frac{D^3 \times R}{125},$$

in which H denotes the horse-power; D the diameter of the shaft in inches, and R the revolutions per minute. In this case the pulley is supposed to be close to the bearing. If now your shaft runs at a speed which will transmit 30 horse-power you may accomplish the desired result.

(525) S. M., Calumet, Mich., writes: Please let me know through your columns the number of men employed under the chief engineers of the steamships City of Paris and the Majestic, or refer me to some one who can give me the information. *A.*—Write a courteous letter to each chief engineer and inclose a postage stamp for a reply. They will undoubtedly give you the desired information. 2. What colors are used for wood, wrought-iron, steel and brass in making drawings of machinery? *A.*—There are no standard colors used for the purpose. All the advantage gained by using colors is to draw attention to the fact that different kinds of material are used, and the kind of material should be plainly written on the drawing, whether colors are used or not. At present blue prints are used to a great extent, so these colors cannot be employed to advantage, therefore all sectional surfaces are in many offices section-lined alike with India ink, and the name of the material written on the drawing. This we believe to be the best practice, although some draftsmen prefer to use different forms of lines to indicate the different kinds of material, but in all cases the section lines on tracings from which the blue prints are to be taken are drawn with ink, or, in other words, they are of the same color. If you prefer to use colors on a finished drawing the following may be employed for sectional surfaces: A light tint of indigo and India ink for cast-iron; for wrought-iron, Prussian blue; for brass, gamboge; for wood, burnt umber; and for steel, Prussian blue and carmine.

(526) W. H. M., Chester, Pa., writes: Kindly answer the following question through your columns. The sketch is plain enough, without further explanation. The question is: Will gravity affect the movement of the weight if the wheel be revolved at a sufficient speed to bring a high tension on the spring? Or will the center of the weight describe a circle concentric with the center of the wheel? *A.*—The weight W is acted upon by the centripetal force and the force of gravity; the former acts in a radial line tending to pull the weight towards the center of the wheel; the force of gravity always acts in a vertical line tending to pull the weight downwards. Hence, when the weight is vertically above the center of the wheel the centripetal force is increased by the force of gravity, because both forces act in the same direction; and when the weight is vertically below the center of the wheel, the



centripetal force is decreased, because in this position the force of gravity acts in a direction opposite to that of the centripetal force. From the above it will be seen that the resultant centripetal force varies during one revolution of the wheel. But this resultant centripetal force is represented by the tension on the spring, and consequently this tension must also vary; therefore the weight W cannot describe a circle concentric with the wheel; in fact, the path described by the center of the weight will not be exactly a circle; but the greater the rotative speed, the nearer will the path of the weight approach a circle concentric with the center of the wheel.

(527) R. W. K., Pottsville, Pa., writes: I am interested in an electric light company who propose putting in three Thomson-Houston 50 light arc light dynamos. The room in the station building is very limited, and the machines will have to be placed in a corner of the room, and power is taken from a 16"x16" 150 horse-power automatic engine with two 7-foot fly wheels, running at 205 revolutions. One dynamo will be driven from the left-hand wheel direct, 19 feet 6 inches from center of fly wheel to center of pulley. Owing to the position of engine, machines and limited space, the right-hand wheel of the engine will have to drive the other two dynamos with only 15 feet between the center of engine wheel and center of one of the dynamo's pulleys. I propose to locate one machine behind the other in line with each other, 6 feet 6 inches from center to center of pulleys, run one belt over the pulleys on the two dynamos, and then connect by a belt the engine wheel and the pulley on dynamo which is furthest away from the engine wheel, the engine belt running over the belt which connects the two dynamos. It will require about 40 horse-power to drive each dynamo. What I would like to know is, first, will either belt have much or more than the ordinary slip? *A.*—If the belts are of even thickness, and the joints carefully made they should have no more slip than an ordinary belt. 2. Will a 16-inch belt under the proposed conditions transmit 80 horse-power? *A.*—Yes; if it is a double belt it will transmit more. 3. Will there be any great danger of the journals of the pulleys heating excessively? *A.*—There will be, unless you have the journals of the dynamo specially constructed for your arrangement of belts. 4. To sum it all up: Will it be a satisfactory arrangement? *A.*—Yes; there are a number of belts, arranged as you speak of, running satisfactorily.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Ready-made cut Iron list gears. See page 20.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link Belt in use.

Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

$13.00 I Dea L. Drawing Stands. The original. Send for postal. W. S. Rogers, Troy, N. Y.

S. A. Smith, 23 South Canal Street, Chicago, Ill., agent for Holbrook's Raw Hide Blanks for Gears.

Our Automatic Gear Cutting Machine will increase production 50% The Superior Mach. Wks., Clev'd, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Planer Chucks and 13" Upright Drills. For cuts and price address G. W. Jordan, No. 4 Wayne Street, Worcester, Mass.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

Save small iron from foundry refuse. It pays. Use the Woodruff Pat. Separating Machine, Audubon Machine Works, New Haven, Conn.

Thos. Pray, Jr., 193 *Times* Build'g, N. Y., attends to calls for Indicating and Testing Steam Plants, Water-works, Locomotives & S. S.'s. Write or call.

Prompt Delivery.—New cutting-off machines made in two sizes, 2⅛ and 4⅛ inch. Send for circular. W. P. Davis, Rochester, N. Y.

N. Y. City Bolt & Nut Co., Limited, 33 and 35 Desbrosses St., N. Y. City, manufacturers of Machine Bolts of every description. Write for estimates.

Milliken & D'Amour, No. 151 Cedar Street, New York City, designers and builders of labor-saving and automatic machinery and tools to order.

"Roper's Hand-books for Eng'rs and Firemen." Descriptive Catalogue mailed free to any address. Edw. Meeks, Pub., 1012 Walnut St., Phila., Pa.

25" / 32" / 37" / 42" — "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, Newark, N. J.

Complete treatise on Screws and Screw-making, with clear and concise explanation of the methods; 95 illustrations. Price, $1.25 postpaid. E. & F. N. Spon, 12 Cortlandt Street, New York.

"Hawkins' Calculations for Engineers," 10 Parts, 25c. each, bound, $2 50; Catalogue free; Theo. Audel & Co., Pubs., 91 Liberty St., N. Y.

Brown & Sharpe Mfg. Co., Providence, R. I., announce that the prices of their Swivel Vises for use on milling and planing machines have been reduced. Price of the No. 2 vise is $24.00; price of the No. 3 vise is $30 00. Former prices, $31.00 and $38 00

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1 00 each, and the "New Handy," mailed at 50c. each The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy" By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

MANUFACTURES.

A tin-plate mill is to be erected at Blairsville, Pa.

Philip Cornell will erect a steam mill at Blackney, Pa.

C. A. Mann has built a new machine shop at Providence, R. I.

The Gloucester (N. J.) Manufacturing Company will enlarge its plant.

A machine shop will be established at Statesboro, Ga., by W. W. Davis.

The Hatch Cutlery Company will erect a new factory at Milwaukee, Wis.

A system of water-works will probably be constructed at Weston, W. Va.

A foundry plant is to be established at Wallace Ida. T. J. Heine is interested.

Murray & Porter will establish a foundry and machine shop at Jefferson, Texas.

The Haugh-Ketcham Company is building a new $8,000 foundry at Indianapolis, Ind.

The construction of an iron bridge across Beaver Creek, at Bristol, Tenn., is probable.

Sargent, Stone & Co. are erecting a new building at their foundry plant at Machias, Me.

The Taylor (Texas) Ice Company is reported as to put new machinery in its ice factory.

Work has commenced on the erection of the new iron and brass foundry at Brookfield, Mo.

Leavenworth, Kan., is to have a linen factory The capital of the company will be $50,000.

Work has commenced on the foundation of the new reaper and mower plant at Latrobe, Pa.

A new melting furnace is to be added to the equipment of the foundry at Waltham, Mass.

A new electric light company has been organized, to establish a plant at Little Rock, Ark.

An iron foundry and machine shop are being erected by Josiah Holmes at Cumberland, Md.

It is stated that Beavers & Marsh, of Collinsville Ala., contemplate the erection of a cotton-mill.

E. P. Hawland is reported as to erect an iron foundry and machine shops at Flatonia, Texas.

Messrs. Lutz & McDowell will, it is stated, establish a 100-ton phosphate plant near Anthony, Fla.

R. R. Mingus intends to rebuild his machine shops, recently destroyed by fire, at Glasgow, Ky.

The Howe Stove Works, at Tallapoosa, Ga., are about completed and prepared to go into operation.

The Omaha and Grant Smelting and Refining Company will establish a copper plant at Omaha, Neb.

The Snyder-Romans Company, Helena, Ark., has erected machine shop, and will erect a planing-mill.

Spinning and carding machinery is to be put in the new mill of G. H. McDonald & Co. at Cohoes, N. Y.

The Walworth Manufacturing Company is to erect an addition to its foundry plant at Empress, N. Y.

A new foundry building, 300 x 100 feet, is being erected by the Dunkirk (N. Y.) Locomotive Company.

The Milwaukee Car Wheel & Foundry Company, of Milwaukee, Wis., has decided to remove to St Paul, Minn.

The Presque Isle (Me.) Electric Light Company's plant is to be greatly improved, to meet an increasing demand.

Additions and improvements are being made to the steam plant of the Clark Thread Company, at Newark, N. J.

The city of New Braunfels, Tex., has issued $8,000 of bonds for the further improvement of its water-works system.

The Lincoln Iron Works, Rutland, Vt., are making additions to their property, preparatory to increasing their business.

The Louisiana Ice and Storage Company, Baton Rouge, La., will put in new machinery, to have daily output of 25 tons.

St. Clair Abrams is negotiating with northern parties relative to the establishment of an ice factory in Tavares, Fla.

The new foundry and pattern house at the Sullivan Machine Company's plant at Claremont, N. H., is nearly completed.

The Mascoma Flannel and Electric Light Companies, Lebanon, N. H., are to put in steam power, on account of low water.

The Brown & Hall Wood Machinery Company has let the contract for the erection of its new building at Ogden, Utah.

It is probable that a plant for the manufacture of locomotives on an extensive scale will be established at Columbus, Ohio.

The Chicago, St. Paul & Kansas City road is rebuilding the North St. Paul repair shops which were recently burned.

There is some talk of a wire factory being established at West Bergen, N. J., by a number of Brooklyn (N. Y.) capitalists.

Parties are organizing a stock company to erect works at Little Rock, Ark., for the manufacture of boilers, cotton gins, plows, etc.

C. Drew & Company have increased their manufacturing output by adding new machinery to their machine shop at Kingston, Mass.

The Fernandina (Fla.) Light and Power Company will, it is stated, improve and increase the capacity of its electric light plant.

The Lynchburg Cotton-mill and Improvement Company, Lynchburg, Va., will put in an additional engine and boiler and 5,000 spindles.

It is rumored that a $1,000,000 car works plant will be erected in Roanoke, Va. The Buena Vista Land Company can give information.

The Courtwright Manufacturing Company, makers of railroad supplies, will remove their factory from Detroit to Benton Harbor, Mich.

The James Stewart Manufacturing Company has begun the construction of its extensive foundry and stove works at Woodstock, Ontario.

The Morris Avenue Machine Works, Birmingham, Ala., has introduced in its plant the manufacture of the Jones water-packed plunger pump.

The Western Tap and Die Company, of Chicago has been formed, with capital stock of $12,000, by F. B. Furniss, L. Furniss and G. F. Worth.

C. H. Smith, county clerk at Pleasant Hill, Md., invites estimates on the cost of a bridge to be constructed over Brown's Run, near that place.

The Louisville & Nashville Railroad Company (office, Louisville,) will, it is stated, erect repair shops and roundhouse in Montgomery, Ala.

The Hutchins Machine Company, of Worcester, Mass., has about completed the arrangements for the manufacture of the Hall Mowing Machine.

The Texas Iron Rolling-mills, Fort Worth, Texas, have filed an amendment to their charter, authorizing the removal of their headquarters to Tyler.

The Ætna Machine Company has been organized at Springfield, Ill., for the operation of a foundry and machine works. The capital stock is $15,000.

The Harper Manufacturing Company, of Peoria, Ill., has been organized, to manufacture patented articles of all kinds. The capital stock is $200,000.

The Western Boot and Shoe Machinery Company has been incorporated at Chicago, Ill., to manufacture boot and shoe machinery. Capital, $50,000.

A stove works plant, to employ about 40 hands, will be established at Bridgeport, Ala. The Bridgeport Development Company can give information.

The Puget Sound Iron Company, of Seattle, Wash., has let the contract for clearing 200 acres of land near Seattle, on which the new works will be built.

The Victoria (Texas) Light, Power and Ice Company is reported as to put a new dynamo in its electric light plant, to increase the capacity of same.

It is stated that the F. A. Thomas Machine Company, of Woonsocket, R. I., has secured control of the Geo. A. Metcalf Machine Shop in the same place.

The Coosa Furnace, at Coosa, Ala., which has been idle all the summer, on account of the low price of iron, will probably resume operations this month.

The Eel River Woolen-mills, of Columbia City, Ind., are to be removed to Kirkland, Ore., in a short time, and the capacity of the plant somewhat increased.

The Weston (Va.) Electric Light, Power and Water Company has increased its capital stock to $15,000, and will put new machinery in its electric light plant.

A power house will be erected at Curtis Bay, Md., by the South Baltimore Electric Railroad Company. It will contain a steam plant of 300 horse-power.

Work on the establishment of the tin-plate mill at Harney Peak, S. D., is progressing rapidly, and the plant will undoubtedly be in operation early in the spring.

The iron roof for the storehouse which the U. S. Government are building at Willett's Point, L. I., will be furnished by the Berlin Iron Bridge Co., of East Berlin, Conn.

It is reported that a rich western man has decided to build a factory for the manufacture of patent horseshoe nails at Rumford Falls, Me. When built it will employ two hundred hands.

It is stated that the Southern Steel Company, of Chattanooga, will greatly enlarge its department for the making of steel by the Bessemer basic process, erecting two 10-ton converters.

Frank C. Roberts, civil engineer, of Philadelphia, is preparing plans and specifications for a new blast furnace to be built by the Pottsville Steel and Iron Company, at Pottsville, Pa.

The Louisville & Nashville Railroad has increased its force at Birmingham (Ala.) shops, and is now doing all the repair work for its lines between Montgomery and Decatur at Birmingham.

The following corporation has been granted a charter at Harrisburg, Pa.; Taylor Engine Company, at Chambersburg, Franklin County; capital stock, $130,000.

The Taylor Decarbonized Iron and Manufacturing Company, of Montreal, Canada, is applying for incorporation, having in view the erection of furnaces and machine shops.

The Linden Steel Company, at Pittsburgh, Pa., is building a new 25 ton open hearth furnace in its mill, and also putting in Siemens gas producers, to supply fuel for the same.

It is proposed to replace the old Saxton's River bridge at Bellows Falls, Vt., with a suspension bridge of iron about 300 feet long. A special meeting will meet soon to consider the matter.

The Sowder Railway Freight Car Company has been incorporated in New York. J. S. May, Philip Engelskirger, E. E. Hughes and others are interested. The capital stock is $2,000,000.

A Texarkana (Texas) party is in correspondence with J. J. Harper, relative to the organization of a stock company for the establishment of an iron foundry, machine and car shops in Monroe, La.

The Atlas Electrical Manufacturing Company, at Chicago, propose to manufacture dynamos, motors, etc.; capital stock, $12,000; incorporators, M. F. Matteson, Q. A. Stephenson and J. B. Albertson.

It is stated that northern parties have made a proposition for the establishment in San Antonio, Tex., of a rolling-mill, iron and steel plant, and nail and wire works, at a total cost of about $2,000,000.

The two large buildings for the Burden Iron Company, West Troy, N. Y., have been completed. They are of brick, and are substantial. One will be used as a machine shop, and the other as a cooper shop.

The manufacture of metal lath has been commenced by the Niles Iron and Steel Roofing Company at Niles, O. The machinery is running very smoothly, and the samples turned out are of excellent quality.

The Damon Safe and Iron Company, of Boston, Mass., are announced as having decided to locate at Waukegan, Ill., where they will complete and occupy the plant started by the late Chicago Safe and Lock Company.

The Richey Manufacturing Company, at Chicago, will manufacture fuel oil gas generators; capital stock, $10,000; incorporators, F. W. Richey, W. W. Knowles, and others.

The Derwent Foundry Company, of Pittsburgh, Pa., will erect a plant at Elwood, Pa., for the manufacture of stoves and brass castings. Elwood is a new manufacturing town, located about thirty miles from Pittsburgh.

The Roller Bearing Cycle Company, at Chicago, has been formed, to manufacture bicycles and machines of like character; capital stock, $200,000; incorporators, Alfred D. Barnes, Horatio Keeler and George F. Barrett.

The Pulaski Development Company, Pulaski, Va., are pushing the work on their furnace. They expect to put it in operation January 1. It will have a daily capacity of 150 tons. Work on the Pulaski Rolling-mill will be resumed at an early day.

The Farmers' Supply Company has been organized at Macon, Ga., to manufacture and deal in fertilizers and to import German kainit. A. M. Rodgers is president, and A. C. Fulton, secretary and treasurer.

Articles of incorporation have been filed by the J. H. Kerrick Machinery Company, at Minneapolis, Minn. The capital is $50,000, and the business will be that of manufacturing iron and wood-working machinery.

A corrugated iron roofing factory of Cambridge, Ohio, contemplates moving to Kankakee, Ill.; will erect a large plant, etc., to employ not less than 50 men. The consideration is the donation of 2½ acres and a cash bonus.

The four blast furnaces of the Pennsylvania Steel Company, at Steelton, Pa., are now in blast, No. 4 stack having been blown in last week. Three stacks are running on Bessemer iron, and the third is making spiegel.

The Gilbert & Bennett Company, a Georgetown (Conn.) firm, will erect a four story 40x168 foot factory at Chicago, Ill., for the manufacture of wire goods. Three more stories will be added to the building when necessary.

The Maryland Bolt and Nut Company, Curtis Bay (P. O. Baltimore,) Md., has erected its plant, and will commence operations about November 15. The principal building is 336x70 feet; estimated out put of bolts daily, 100,000.

L. O. Gibbs and Geo. Coleman are investigating with a view of establishing a plant in Ocala, Fla., for the manufacture of white lead according to their patent process; the works are to have a daily capacity of 47,200 pounds of lead.

The Andrews Anti-Friction Journal Company, of Syracuse, N. Y., has been formed, for the manufacture and sale of journal bearings by Jas. M. Andrews, M. A. Andrews and Chas. E. Fish, of that city. The capital stock is $10,000.

The Hall-Kirsch Steel Company, at Anderson, Ind., has filed articles of incorporation, with a capital stock of $65,000. It is intended to establish a plant for the manufacture of steel billets and steel castings, at Irondale, near Anderson.

Worman & Hazlewood, bicycle manufacturers, limited, of Coventry, Eng., are considering the advisability of establishing a factory in this country. The recent advance in the duty, which interferes with their trade, is the cause of this action.

The Holyoke (Mass.) Machine Company is beginning work on a new building opposite the present works, which will be about 50x150 feet, two stories, and will be used to enlarge the company's facilities for the manufacture of paper and other machinery.

There is water-works agitation in La Grande, Ore.; Mancelona, Mich; Weston, W.Va.; Parkland, Ky.; Burkesville, Ky.; Seymour, Conn.; Glens Falls, N. Y.; Cincinnati, O; Norma, Okla; Purcell, I. T; Riverside, R. I.; Woodstown, N. J., and Port Henry, N. Y.

Bovaird & Seyfang, of Pittsburgh, manufacturers of oil well supplies, who have works in that city and also in Bradford, Pa., have been granted a charter of incorporation under the style of the Bovaird & Seyfang Manufacturing Company, with a capital stock of $500,000.

The Ashe Manufacturing Company, capital stock $500,000, $50 paid in, has been organized at Portland, Me., for the purpose of manufacturing and leasing machinery. The officers are: President, Robert Ashe, of Boston, Mass.; treasurer, James F. Chase, of Boston, Mass.

The Henley Machine Tool Works, of Richmond, Ind., have just occupied the large new addition to their factory. They are very busy and report increased demand and sales of their pulley lathes. The company has recently shipped six pulley turning lathes to various parts of the country.

Watson & Stillman, 204-210 East Forty-third street, New York, call the attention of the railroad world to the fact that they have brought out a new size hydraulic jack of a capacity of thirty tons, and having a height over all of 37 inches, and a rise of 22 inches. This jack was specially designed for lifting palace cars.

George Bullock, S. R. Benton, C. B. Smirall, of Cincinnati, Ohio, and others have incorporated the Cincinnati & Covington Rapid Transit Bridge Company, for the purpose of constructing a bridge across the Ohio River, to connect Madison avenue, in Covington, Ky., and Race street, in Cincinnati. The capital stock is $5,000,000.

Hammacher, Schlemmer & Co., 209 Bowery, New York, have issued a very neat catalogue and price list of tools for cabinet makers, pattern makers, upholsterers, carpenters, wood carvers, sculptors, masons, plasterers, plumbers, gas fitters, painters, glaziers, paper hangers, machinists, jewelers, etc. It is worth having and preserving.

The Steel Car Company will go to Providence, R. I., where a prominent capitalist offers to invest largely in the stock of the concern and give to the company gratis ten acres of land in a most desirable location. If the company had been able to secure quarters at the Locomotive Works, Taunton, Mass., this place would have had a new industry.

William Cramp & Sons' Ship and Engine Company, of Philadelphia, are making extensive changes in their plant, and have placed the contract for a new boiler shop with the Berlin Iron Bridge Company, of East Berlin, Conn. This boiler shop will be constructed entirely of iron, and will be composed of two parts, one part 55 feet in width by 350 feet in length, made very high between joints, on account of moving large marine boilers over each other. This portion of the building is controlled by a 50-ton traveling crane, which is to be furnished by William Sellers & Co., of Philadelphia. Connected with this main portion will be a wing 58 feet wide by 370 feet long, served the whole length by a 20-ton Sellers' traveling crane. The building is composed entirely of iron, from the designs of the Berlin Company, and will be very complete in every detail.

America Leads in This.

It may interest housewives to know that it is not the elegant thing to speak of a piece of furniture as imported, or coming from the other side, as one speaks proudly of a gown or bonnet. People of means are buying the furniture made from American designs in their own country at just three times the expense of the imported article. American designs are acknowledged the most artistic of the period, and yet there is neither an American school of design for this particular branch or any marked characteristics by which it is distinguished. The American designer originates his idea, formulates a rough little outline of it, hands it over to his French and German draftsmen, who work it out with the patient and painstaking skill which the designer is in too much of a hurry to spend his precious time over. This design is executed, and when completed is sold to the connoisseur who appreciates the difference in the durability and beauty of the home product, and willingly pays the advanced price.

One of the prominent designers, speaking on this subject the other day, pointed out two small inlaid tables standing together in his office, each equally artistic, but the one of American make more than double the cost of the importation. "The American table will last forever, the French one will check in three months, owing to the change in climate," he explained, "and yet we may tell this to one hundred customers and only the one exceptional buyer will pay the difference in cost. That is one of the difficulties under which the development of American art labors. Again, we have no schools for study; for, if we had the schools, who could be the professors and instructors in these schools of American art? Some one suggested that I should; but I am not capable of filling the place, and wouldn't accept it if I were competent. I have studied eighteen years and don't know anything about it yet. The American designer has learned what he knows by hard knocks, not soft ones; by failures, not successes; by practical experiments, not theories; and he is not going to give the result of his life struggle for the stipend allowed to teachers of anything. He cancels his debt to the world by giving those that follow him the results of his experience in his work. Just now the American style is like the American people, cosmopolitan — its individuality has not crystallized, and yet it is unlike anything on the other side. There are so many sights. There are fifty men of authority in this branch of fine art. If one of the fifty announces his view as the right one, all the other forty-nine rise up and dispute him, and each one of them is equally as right as he, because we have as yet no established standard. We are studying the best the world has known in all periods, and from them are evoluting American art. But we are too young a people to have a definite idea of our peculiar style familiar to the world outside the profession. We must have years, not only to perfect our individuality, but to impress it upon the world and to elevate public taste into creating a demand for our best results, even at an advance in price.

"The American product must be at a premium because it is American, just as the imported article sells among artificial people, not on account of its worth or beauty, but because it is imported."—*New York Sun.*

Parallel Motions.

BY PROF. A. MACLAY, GLASGOW, SCOTLAND

SEVENTH AND LAST PAPER.

Example 19.—*To draw a combination kite and spear head parallel motion having two points moving with strokes S_1 and S_2.*

Draw a horizontal $X\ X$, Fig. 19, and a perpendicular $Y\ Y$ intersecting at D. From D along $Y\ Y$ to each side of $X\ X$ measure off $D\ D' = D\ D_{,,} = \frac{1}{2}S_1 = 3'\ 10''$. (Scale $\frac{1}{12}$.) Assume a point A on $X\ X$ as a fixed center (making $D\ A$ say not less than $\frac{1}{2}S_1$) and join $D'\ A$. Next assume a point C'' on $D''\ A$ (making $C''\ A$ say less than $\frac{1}{2}A\ D$). Bisect $A\ C''$ by a line intersecting $X\ X$ at B, and with B as center, radius $B\ A$, draw a circle $A\ C''\ C$. Again with A as center, radius $\frac{1}{2}D''\ C''$ draw a circle $E\ H\ G$. Produce $D''\ A$ to cut this circle at G_0. Then with center C radius $C''\ G_0$, cut the circle $C\ H\ G$ at H and G. Join $B\ C$, $C\ H$, $C\ G$, $H\ A$ and $G\ A$. Produce $H\ A$ and $G\ A$ to cut the circle last drawn at F and E. Lastly join D to E and to F. Then $A\ B\ C$ .... H is the required mechanism, with $A\ B$ as fixed link.

For a second point having a stroke S_2, determine a point K on $X\ X$ such that $A\ K : A\ D :: S_2 : S_1$. Through K draw $K\ L$ parallel to $D\ E$, meeting $A\ E$ produced at I, and $K\ M$ parallel to $D\ F$, meeting $A\ F$ produced at J. The extension $E\ I\ K\ J\ F$ is, as in the last case, equivalent to placing a parallelogram $E\ L$ upon $A\ E$ and $E\ D$, or a parallelogram $F\ M$ upon $A\ F$ and $F\ D$. Show by drawing the complete mechanism in several positions relative to $A\ B$ as fixed link, that the centers D and K move in the parallel lines $Y\ Y$ and $Y^1\ Y^1$ with strokes S_1 and S_2 respectively.

Example 20.—*To draw a Hart parallel motion having two points moving with given strokes S_1 and S_2 respectively.*

Determine the points $A\ B\ C\ D\ E\ F$ (Fig. 20) in the same way as the points $A\ B\ C\ G\ E\ D$ were obtained in the last example (Fig. 19) Thereafter produce $E\ F$ to G, making $F\ G = F\ E$, and produce $D\ C$ to H, making $C\ H = C\ D$. Join $H\ G$. Then $D\ E\ G\ H$ represents a contra-parallelogram or Hart cell, which, when the points $A\ B\ C\ F$ are taken at the same proportionate distances apart, gives the same result for F's motion, as the Peancellier cell, similarly arranged with $A\ B$ as fixed link. Its relation to the kite and spear head combination of Fig. 19 may be seen by finding the symmetrical points $M\ N$, Fig. 20, and drawing $M\ A$, $M\ C$, $N\ A$ and $N\ F$. The part $A\ B\ C\ D\ E\ F$, Fig. 20. will then be recognized as just one-half of the similarly situated part of the mechanism, Fig. 19.

For a second point to copy the motion with a stroke S_2, on $X\ X$ determine a point L, such that $A\ L : A\ F :: S_2 : S_1$. Through L draw $L\ K$ parallel to $D\ E$, meeting $E\ G$ at G. Complete the mechanism by connecting L, F and A by parallelograms, such as $G\ J$ and $E\ I$.

Show by drawing that F and L move in the parallel straight lines $Y\ Y$ and $Z\ Z$ with strokes S_1 and S_2 respectively.

Example 21.—*To draw a Kempe parallel motion having three points moving with strokes S_1, S_2 and S_3.*

Draw $X\ X$, Fig. 21, and perpendicular to it $Y\ Y$ intersecting $X\ X$ at F. On $Y\ Y$ to each side of $X\ X$ cut off $F\ B' = F\ B_{,,} = \frac{1}{2}S_1 = 6'\ 3''$, say. (Scale $\frac{1}{12}$.) From any point B on $Y\ Y$ between B' and $B_{,,}$ and from F with radius $B\ C = F\ C = \frac{1}{4}S_1$, draw arcs intersecting at C. From F along $X\ X$ measure off $F\ G = \frac{3}{8}S_1$. Then from B and from G with radius $B\ A = \frac{1}{2}S_1$, and $G\ A = \frac{1}{8}S_1$, draw arcs intersecting at A. Next, from A and C as centers with radius $A\ D = \frac{1}{2}S_1$, and $C\ D = \frac{1}{4}S_1$, draw arcs intersecting at D. Lastly, along $D\ A$ measure off $D\ E = G\ A = \frac{1}{8}S_1$, or through F draw $F\ E$ parallel to $G\ A$. Then $A\ B\ C\ D\ E\ F$ represents the Kempe cell—a kite in which the longer arms are twice the length of the shorter, having a second kite of half the size placed internally on one of the shorter arms of the first. It has the property that, if the points B and F are made to approach each other, the imaginary line joining them is always perpendicular to the opposite link $A\ D$. $A\ B\ C$.... G represents an application of the cell as a straight line motion, with $F\ G$ as fixed link. Show by drawing the mechanism in several positions that the center B moves in the straight line $Y\ Y$ between the limits $B'\ B_{,,} = S_1$, a distance equal to twice the length of the long links, or four times the length of the short ones of the lar. er kite.

Again, for a second point to move parallel to B with stroke S_2, draw a line through $G\ B$, and produce it to a point K, such that $G\ K : G\ B :: S_2 : S_1$. Then connect K by parallelogram with B and G. Similarly for a third point, which, for example, may be required to move in the opposite direction from B and K, produce $B\ G$ to a point N, such that $G\ N : G\ B :: S_3 : S_1$, and connect N by parallelogram with G and B. Then show by drawing that K and N will move in lines $K\ K^1$ and $N\ N^1$ parallel to $Y\ Y$ with strokes $K''\ K_{,,} = S_2$, and $N''\ N_{,,} = S_3$.

Note that B may be considered as a point on the circumference of the circle $B\ F\ D$, and the latter as a circle rolling upon the outer circle $B'\ P\ B_{,,}$.

Fig. 19.

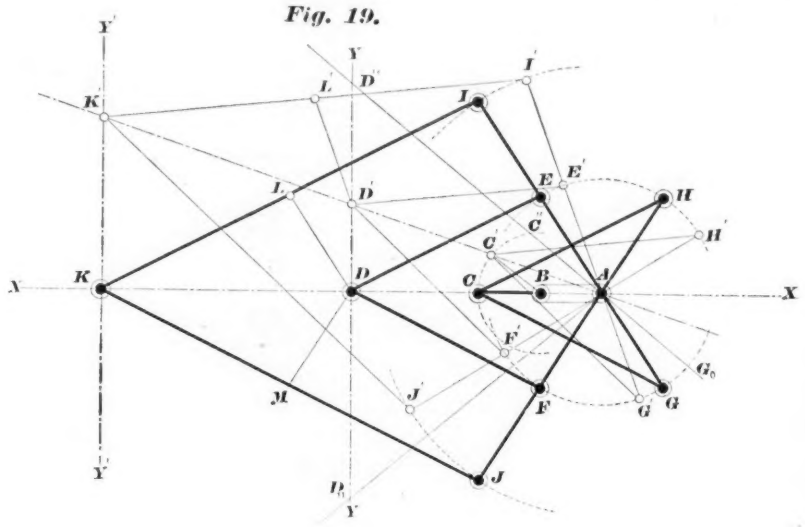


Fig. 20.

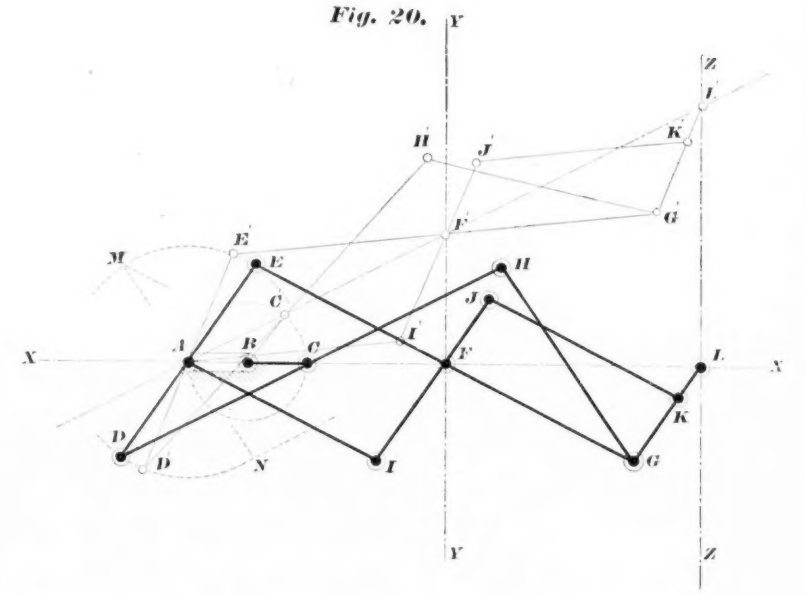
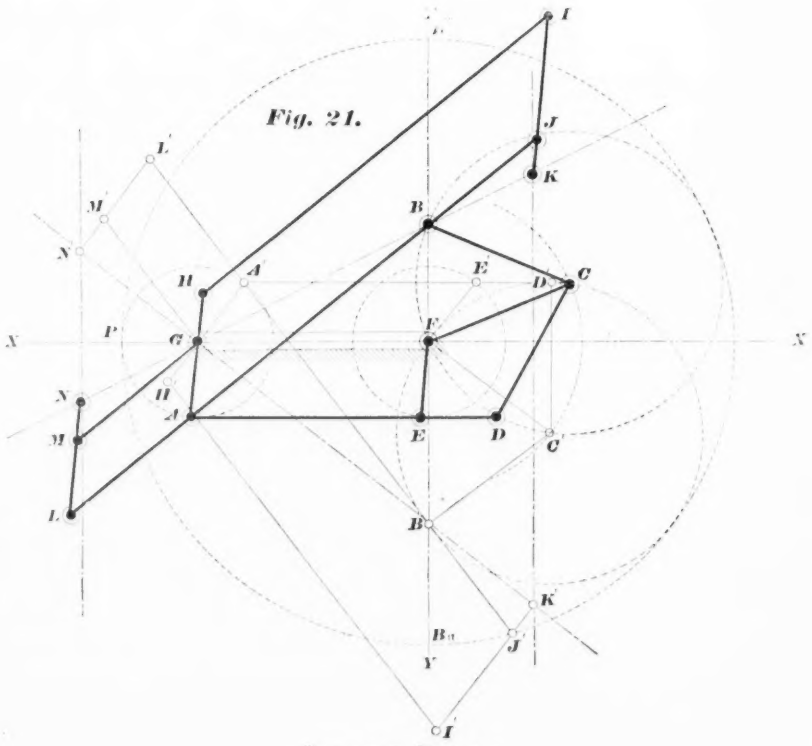


Fig. 21.



PARALLEL MOTIONS.

It is said that a New Jersey farmer recently found pearls to the value of $700 in a small stream near his house.

Mr. E. J. Armstrong, formerly with the Straight Line Engine Co., of Syracuse, has been for the past year engaged in designing a high-speed engine for A. Robb & Sons, of Amherst, N. S. Completing his work there recently, he was pretty agreeably surprised by having presented to him, by the company, a pair of steam engine indicators of approved type. It was a very appropriate present.

Machinists' Supplies and Iron.

NEW YORK, November 28, 1891.

Iron—American Pig—There is still an active demand and sales are made at easy prices.

We quote Standard Northern brands, No. 1 Foundry, at $16 to $17; No. 2 is selling at $15 to $16.50, and Grey Forge at $13.75 to $14.50. Southern brands of good quality are obtainable at $16 to $17.50 for No. 1 Foundry; $15.50 to $16 for No. 2; and $14.25 to $14.50 for No. 3.

Scotch Pig—We quote Coltness at $23, and Eglington at $20.50.

Antimony—The market continues to be very strong, the supply being still short.

We quote Hallett's at 12¾c. to 13c.; Cookson's at 16¼c. to 16¾c.; and L. X at 15¼c. to 15½c.

Copper—The market is still very quiet, very little business having been done during the week. Lake is dull at 11⅛c. to 11¼c. Casting copper is still very scarce, and is held at 10⅞c. to 11c.

Lead—There is little demand from consumers, but, as holders look for a firmer market, prices are well maintained. Pig-lead is held at 4.35c. with 4.25c. offered.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Machinist and draftsman, experienced in managing men, wants position. Box 9. AM. MACH.

An experienced and skillful mechanical engineer desires permanent engagement. First class reference. Address Box 100. AMERICAN MACHINIST.

Foreman of machine shop wishes to change; experience on engine and general machinery; experience with indicator. J. A., AM. MACH.

Wanted—A position by a mechanical engineer; 12 years experience designing modern machinery. Address W., care AMERICAN MACHINIST.

Wanted—Skillful pattern maker to instruct students. State wages wanted, experience, etc. University of Notre Dame, Notre Dame, Ind.

Mech. draftsman, with technical education, wishes work; stationary or marine engine work or anything; age 32. Address Ben, Box 18, AM. MACH.

Wanted—A first-class man as assistant manager in bicycle works; must be conversant with machine work and drawing. Apply by letter to the Crawford Manufacturing Company, Hagerstown, Md.

Wanted—Situation by a first class sheet-iron worker; can do steam-tight work, estimate and order stock; have had 15 years' experience as foreman; best reference. Address Sheet-iron, AM. MACH.

Wanted—Situation by mechanical draftsman and practical mechanic, on special or light machinery; can design, construct or take charge of construction. BOX 7, AMERICAN MACHINIST.

Position as foundry foreman; am thoroughly acquainted with all branches of molding, loam, green or dry sand; melt and mix iron of any grade; engine and furnace work a specialty; am at present in charge of a foundry working 30 molders; good references. L. M., AMERICAN MACHINIST.

Wanted—Brass molder capable of taking charge of a brass foundry for a large mfg establishment in Ohio. Must understand thoroughly the molding and mixing of metals, and producing castings quickly and cheaply. A steady position to the right man. Address G P., care AMERICAN MACHINIST.

Wanted—Position as superintendent or engineer, by one with experience in modern steam plants and their management; has large acquaintance with engineers, and can command some trade; has designs in heavy and compound engines that are indorsed by the best engineers; would like to form connection where interest in business can constitute part of salary. Address Eng., AMER. MACH.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Corliss engs. and gen. mach'y designed, working drawings made. A. W. Jacobi, 136 Liberty St., N. Y.

Special machinery designed and built. C. F. Langston & Co., 70 N. 4th St., Philadelphia.

Special leather and cement for covering pulleys; no rivets required; local agents wanted. Crescent Mfg. Company, Cleveland, Ohio.

To manufacture light special and automatic machinery, novelties, models, patterns, tools, etc., by Orange Machine and Repair Works, Orange, N. J.

Wanted—A1 machinist or pattern maker, to take an interest in my machine shop, to manufacture small engines. 2615 & 2617 Strand, Galveston, Texas.

Wanted—Gear Planer—Gleason preferred; second-hand or new. Also a Corliss Engine, 12"x30" or 10" x36" for cash, 36" to 42" planers 12' or longer. Address Box 1, care of AMERICAN MACHINIST.

Wanted to Sell—Patent rights and special tool to manufacture an article of great merit and sure to bring wealth to one that can give attention to it. R. B., AMERICAN MACHINIST.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

A rare opportunity is offered to a man of business ability, with $25,000 to $50,000, to invest in a young established machinery house; to the right party a lucrative position will be given, with full control of his capital; none other need apply to Box 8, AMERICAN MACHINIST.

For Sale—The Woodworth Automatic Steam Flue Cleaner Patent. It is one of the greatest labor and fuel-saving appliances that has ever been offered to the steam using public, and will be disposed of at low figures in order to settle an estate. For circulars and terms address, Helen I. Woodworth, administratrix, Nunda, N. Y.

Fifty farm bells, with hangings complete, for sale cheap. Address as above.

STEEL TUBES
WELDLESS
SMOOTH · COLD DRAWN
John S. Leng's Son & Co. New York.

Bradley Hammers

REPUTATION.
Men test everything in this world by what it produces.

2000 IN USE

BRADLEY & COMPANY,
SYRACUSE, N. Y.
BRANCHES IN NEW YORK AND BOSTON.

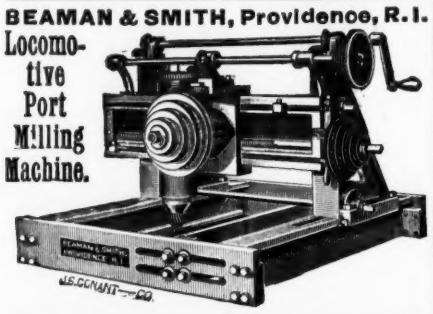
ENGINE RUNNERS' CATECHISM.

Telling how to Erect, Adjust and Run the principal Steam Engines in Use in the United States.

By ROBERT GRIMSHAW, M. E.

18mo, RED CLOTH, - - - - $2.00
JOHN WILEY & SONS, - - NEW YORK.

BEAMAN & SMITH, Providence, R. I.
Locomotive Port Milling Machine.

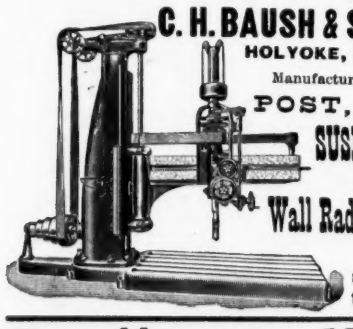


If you buy a KEY-WAY CUTTER without a KEY-MAKING ATTACHMENT

You will make a mistake that will cost you money.

THE MORTON Lightning Key-Way Cutter is the only machine on the market that will cut a Key-Way and make a Key to fit it. Mr. Geo. Newcomb, Salem, Mass., says as follows: "The Key-maker is a wonderful attachment, making keys faster than a man can cut off the steel for it. The Key-way Cutter does a piece of work in fifteen minutes which requires my man seven hours to accomplish by hand." We build machines with stroke varying from six inches to five feet, and cutting from the smallest Key ways to six inches wide. MORTON MFG. CO., Muskegon, Mich. Formerly of ROMEO, MICH.

C. H. BAUSH & SONS,
HOLYOKE, MASS.
Manufacturers of
POST, SUSPENDED AND Wall Radial Drills
From the smallest to the largest.



STANDARD OIL CUPS.

FOR ENGINES & DYNAMOS.

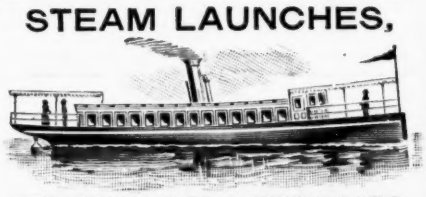
HIGH SPEED MACHINERY.

A. J. WILKINSON & CO.,
184 Washington Street,
BOSTON, MASS.

COMPRESSION SHAFT COUPLINGS.

W. H. NICHOLSON & CO., Wilkes-Barre, Pa.

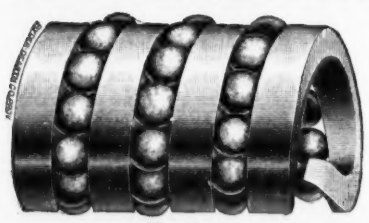
STEAM LAUNCHES,



STEAM YACHTS & TOW BOATS,

HIGH SPEED MARINE ENGINES. All types of boat boilers, including the ROBERTS WATER TUBE SAFETY BOILER with our improvements. CHAS. P. WILLARD & CO., Catalogue free. 5 Dominick St., Chicago.

THE HOWARD MULTIPLE BALL BEARING.



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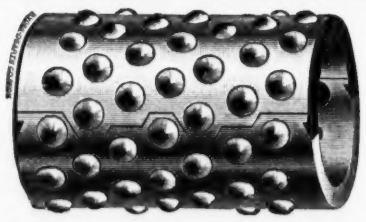

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Applicable to Frictional Bearings in General. Now running at our works and showing a saving of about two-thirds in power.

MOSSBERG MANUFACTURING CO., Attleboro, Mass.

MILLIKEN & D'AMOUR,

151 & 153 CEDAR ST., NEW YORK CITY.

IMPROVED SENSITIVE BENCH DRILL PRESS No. 2.

The most sensitive drill made; spindle runs in phosphor bronze bearings; no expense of fitting chuck to spindle; will drill holes from 0 to 1/2 diam. in center of 10 inch circle; pull of belt does not come on spindle.

SEND FOR DESCRIPTION AND PRICES.

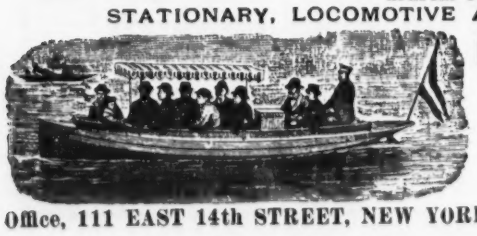
We also make drawings, patterns, models, experimental and fine machinery and tools to order.

DAIMLER MOTOR CO.,

MANUFACTURERS OF

GAS ENGINES

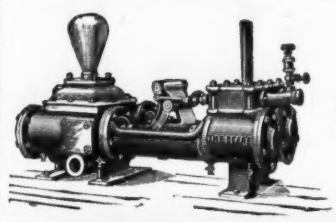
ADAPTED TO
STATIONARY, LOCOMOTIVE AND BOAT PURPOSES.



DAIMLER MOTOR LAUNCHES
18 to 35 feet, 1 to 10 Horse Power.

Safest, Most Speedy, Cleanest, Most Reliable and Convenient Boats. No Steam. No Coal. No Ashes.

Office, 111 EAST 14th STREET, NEW YORK. Next door to Steinway Hall.



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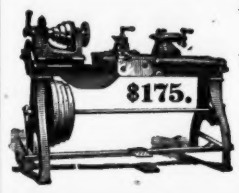
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

FOR TOOLS. **CRESCENT STEEL** FOR DIES.



Improved Screw Cutting Foot and Power. **LATHES**

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.

THE SEBASTIAN-MAY CO.,
167 to 175 Highland Avenue, SIDNEY, OHIO.
MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.

FINE TAPS, DIES, REAMERS, Etc.

LIGHTNING AND GREEN RIVER *Screw Plates.*

Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-Saving Tools. Send for Price List.
WILEY & RUSSELL MFG. CO., GREENFIELD, MASS. New York Office, No. 126 Liberty St.

The Hackney Power Hammer

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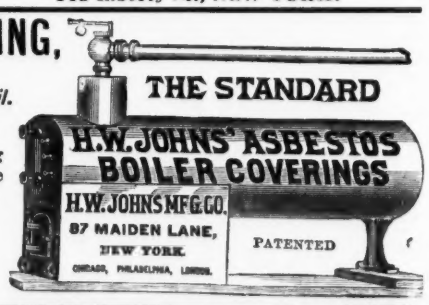

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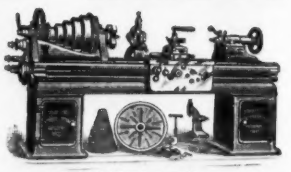

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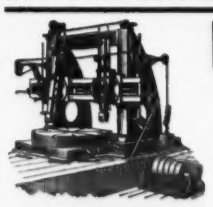

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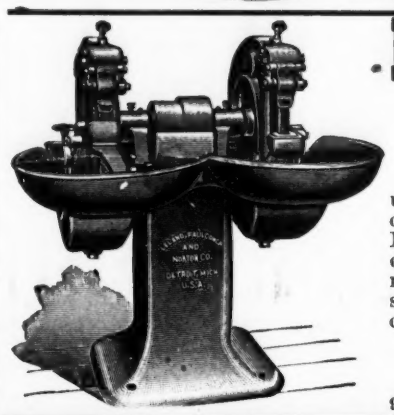

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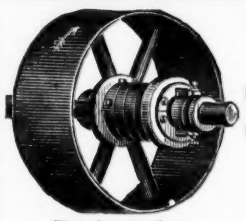

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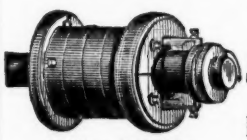

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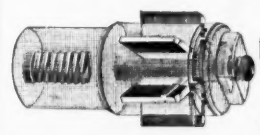

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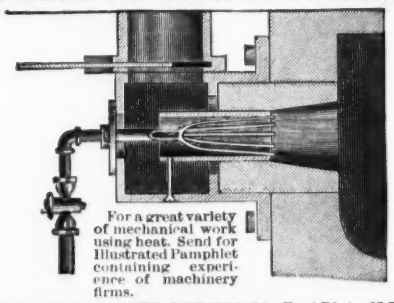

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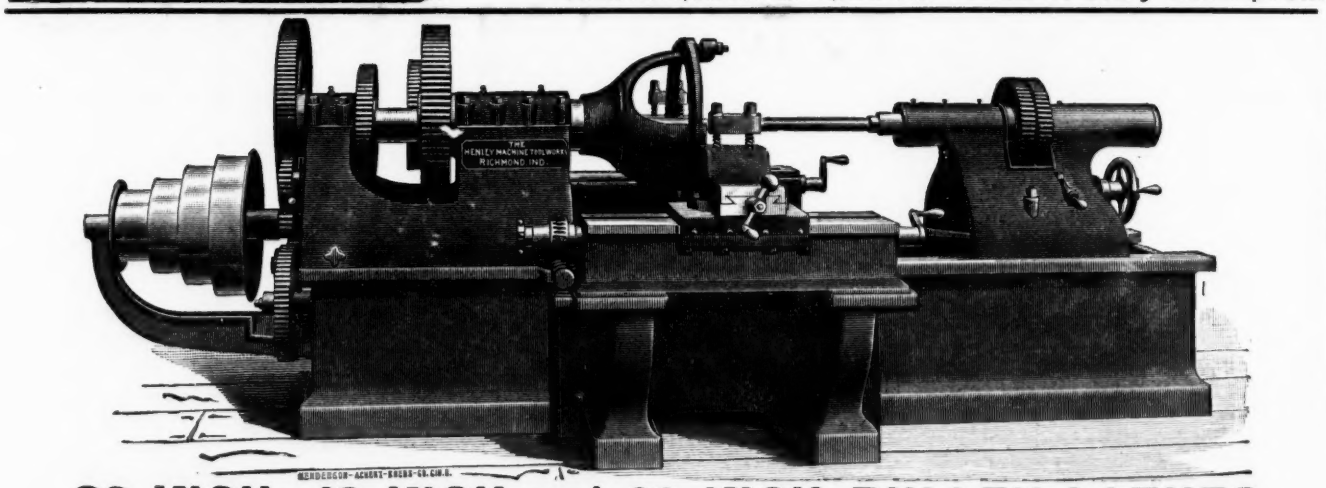

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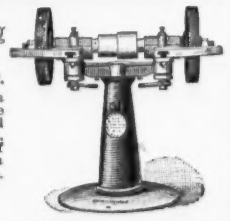

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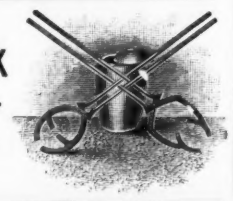

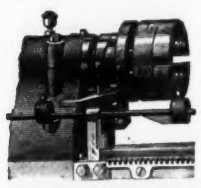

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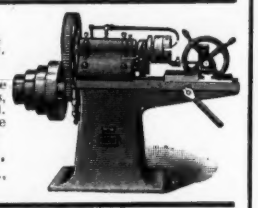

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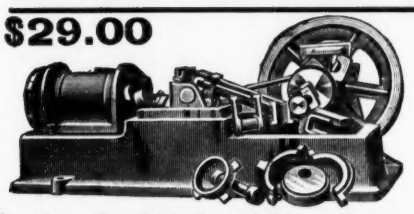

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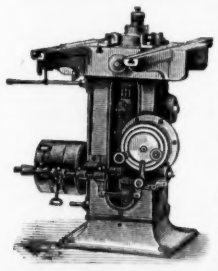

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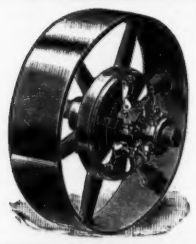

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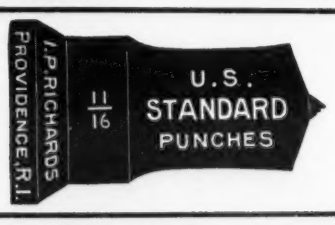

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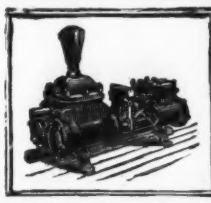

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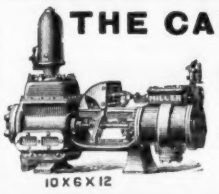

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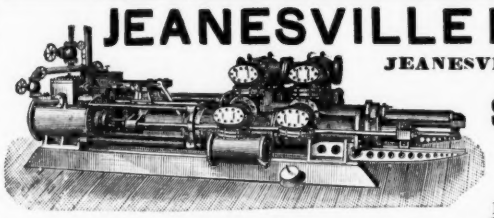

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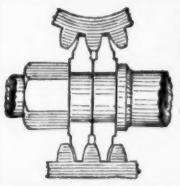

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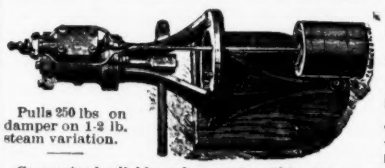

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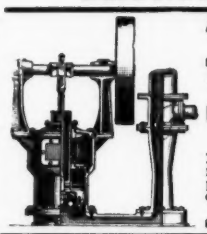

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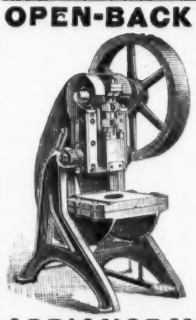

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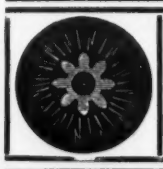

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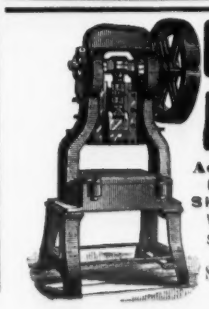

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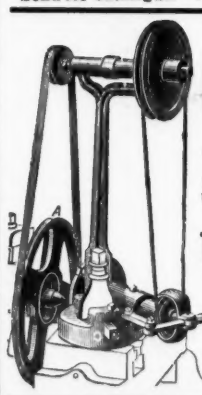

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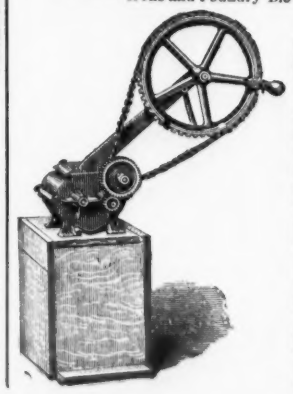

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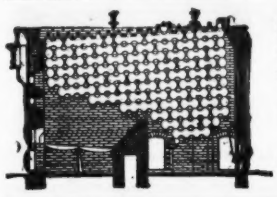

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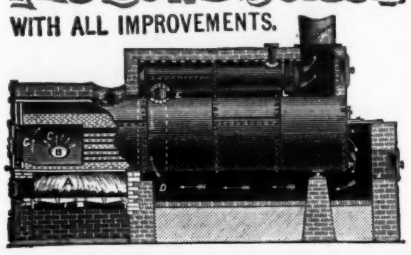

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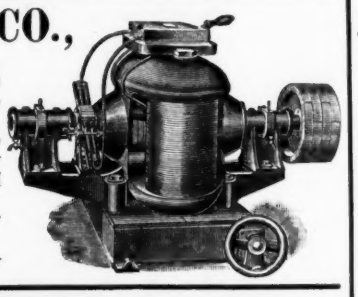

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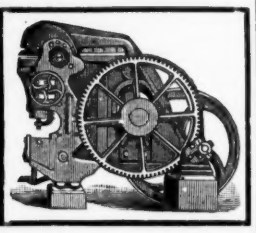

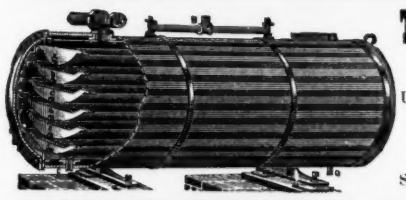

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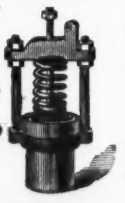

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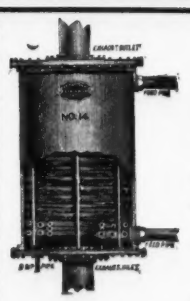

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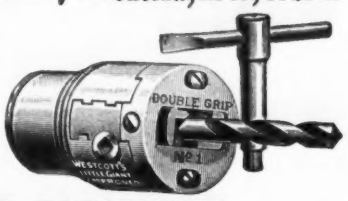

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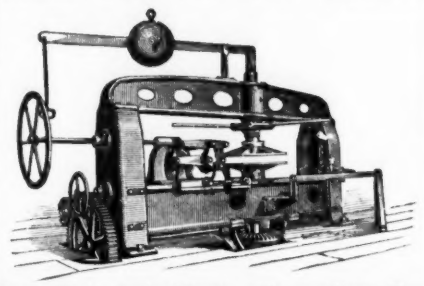

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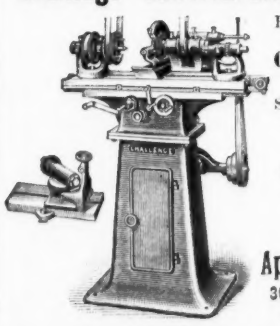

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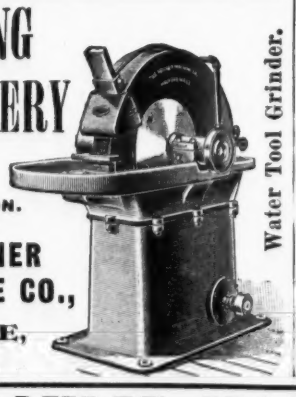

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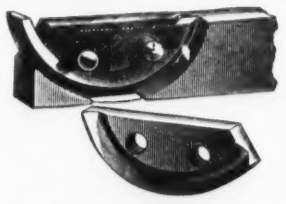

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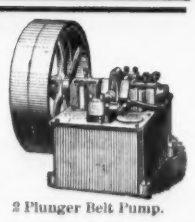

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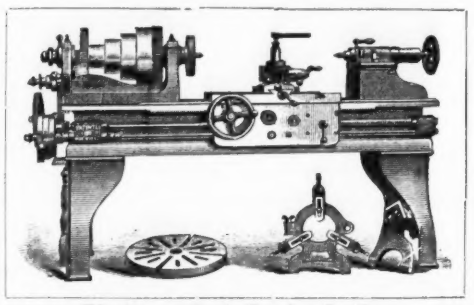

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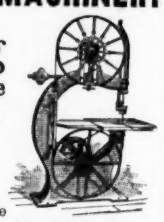

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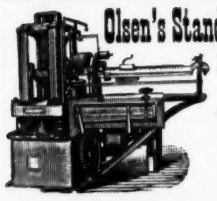

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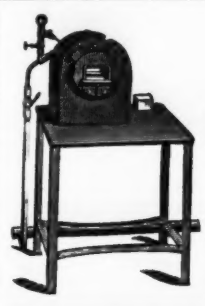

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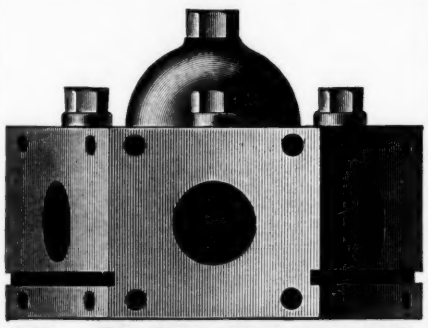

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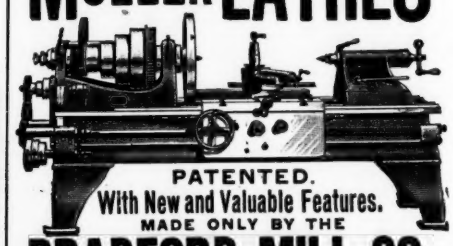

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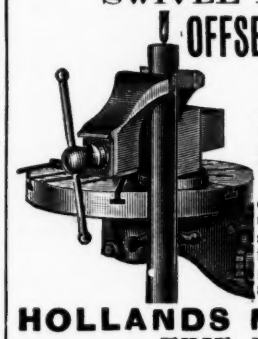

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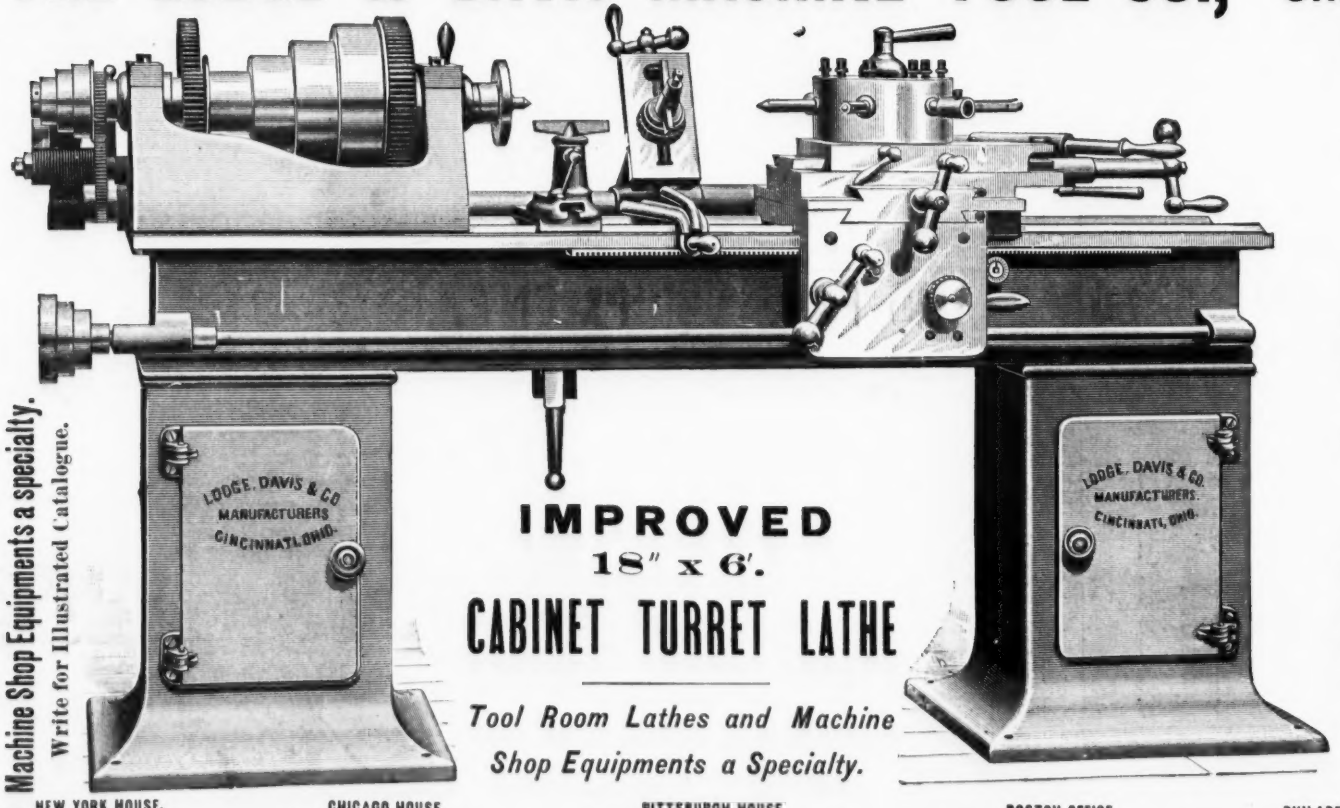

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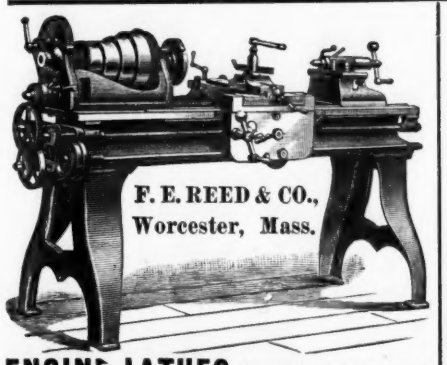

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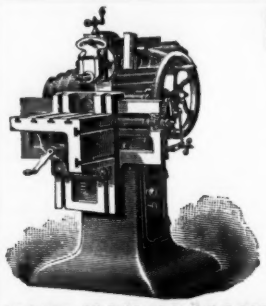

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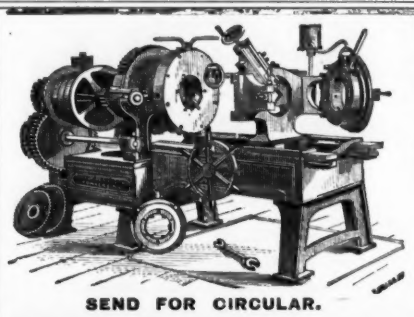

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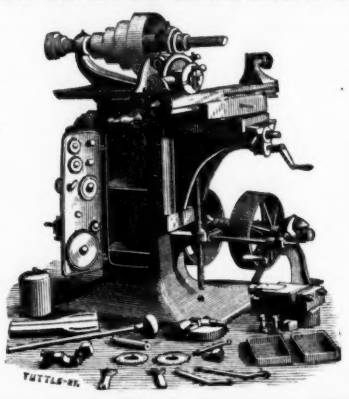

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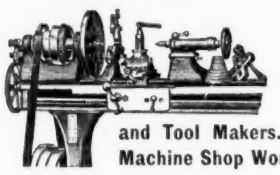

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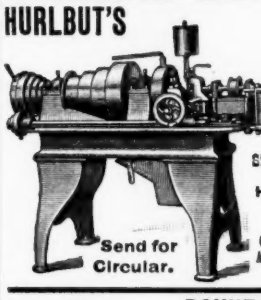

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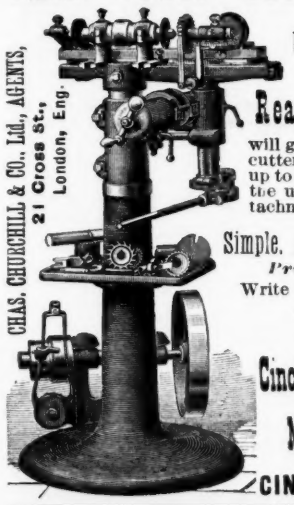

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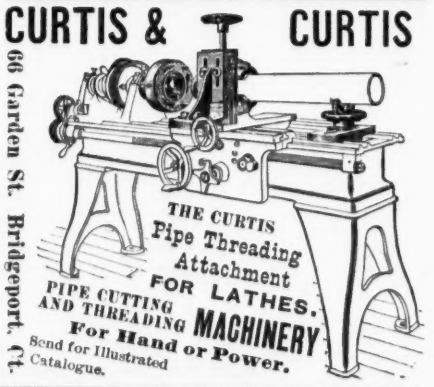

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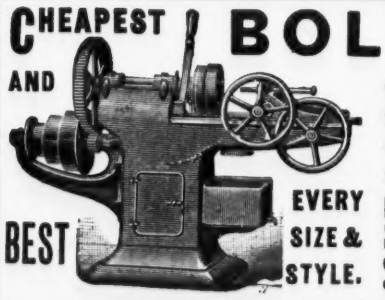

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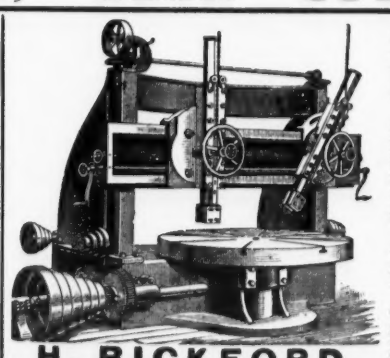

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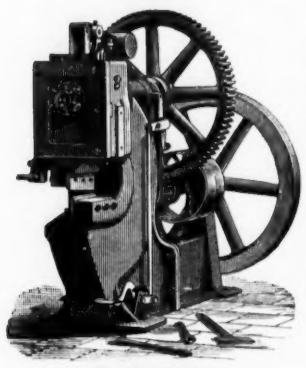
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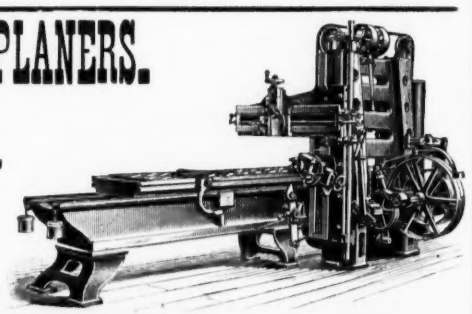

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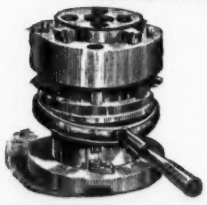
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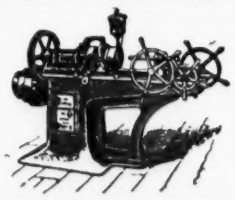

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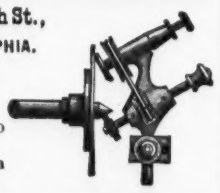

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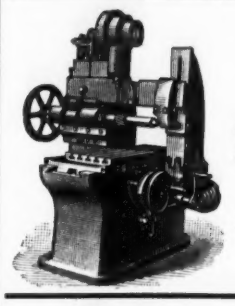
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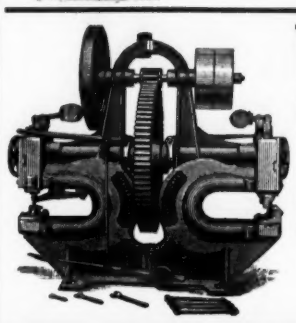
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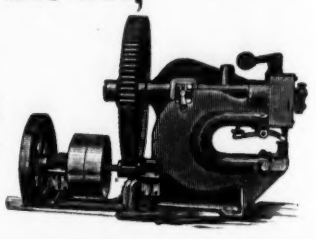

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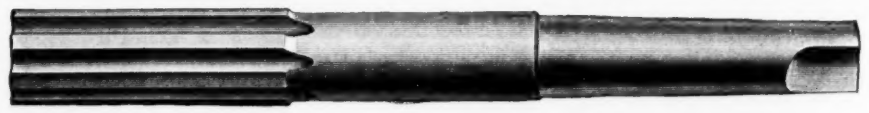
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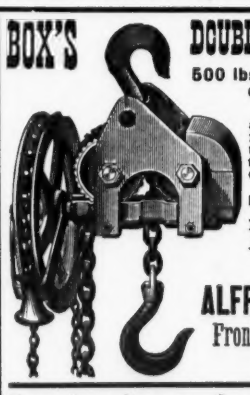
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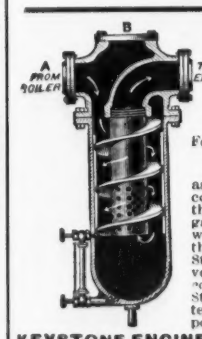

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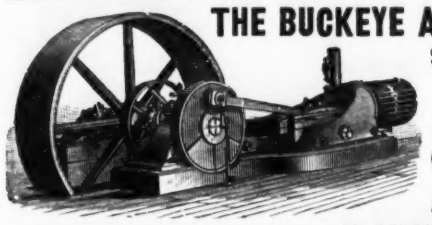

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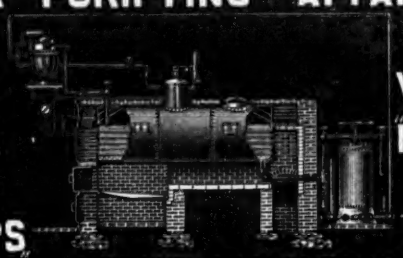

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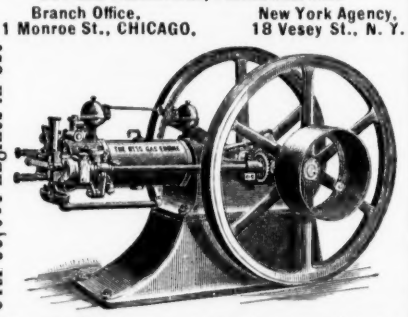

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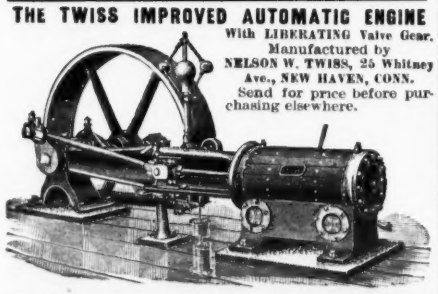

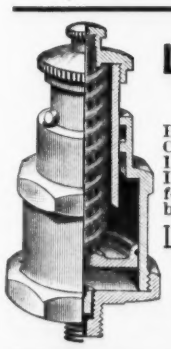

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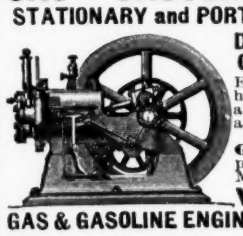

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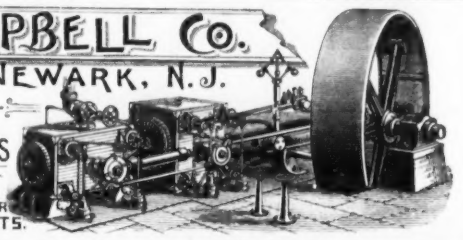

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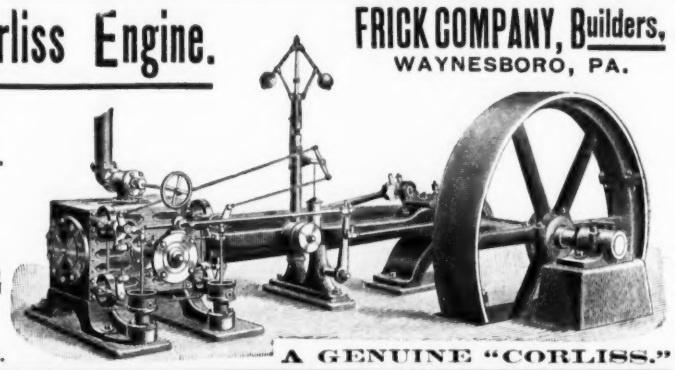

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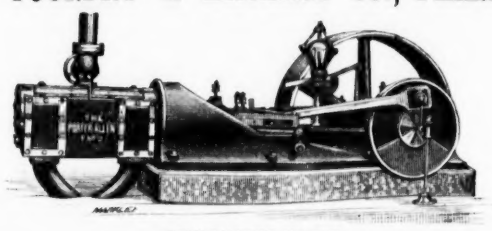

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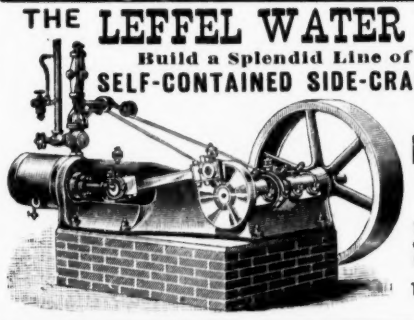

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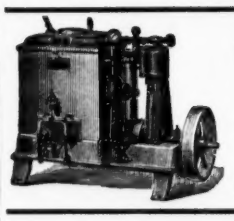

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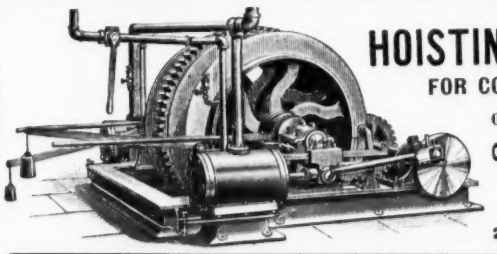

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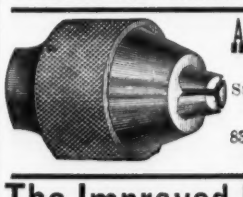

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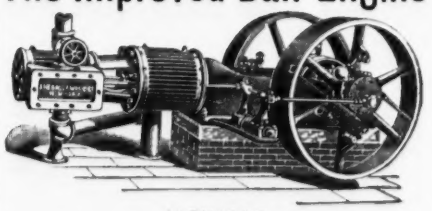

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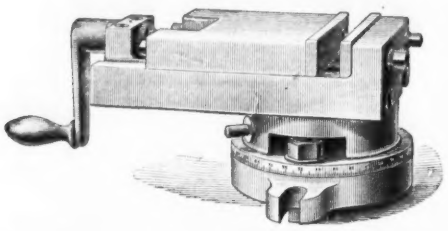

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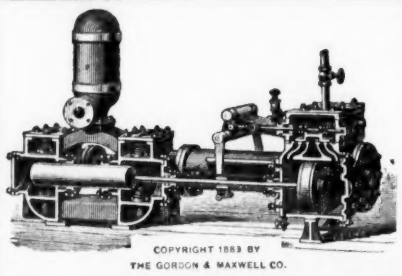

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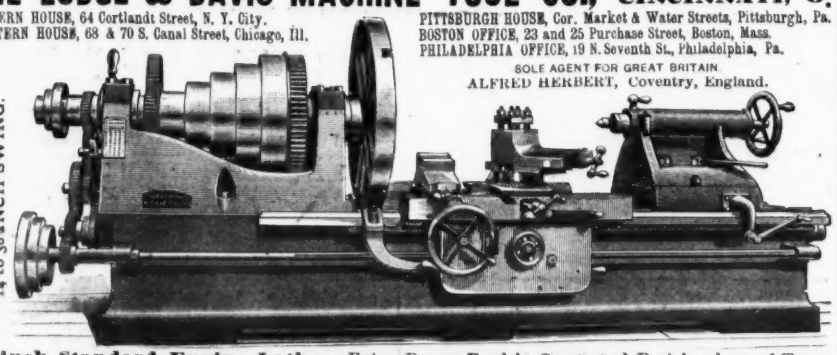

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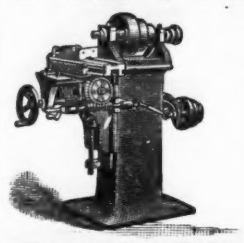

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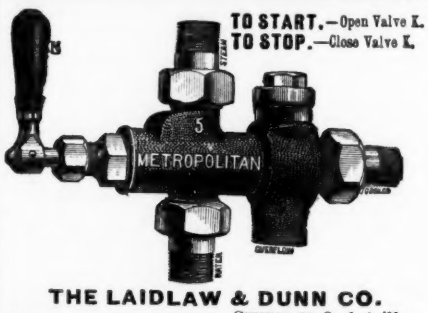

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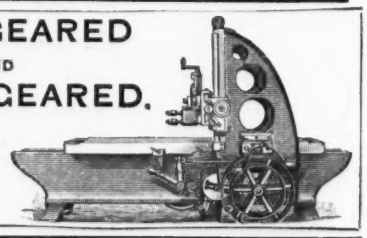

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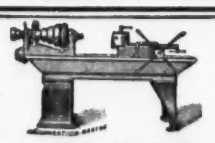
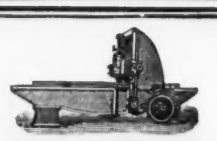


20″ × 6′ Chucking Lathe.



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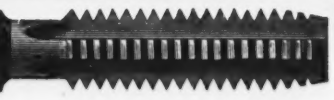
J. M. CARPENTER
PAWTUCKET, R. I.



Manufacturer —of— TAPS & DIES